VIKING LAB'S

# USER'S MANUAL

# SD345
# Spectrascope III
**(Serial Number 181 and Above)**

Scientific Atlanta
Spectral Dynamics Division

MP MASTER
MA29877

SERIAL _____

VIKING LABS / HONEYWELL
370 BERNARDO AVENUE
MOUNTAIN VIEW, CA 94043

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## (Serial Number 181 and Above)

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Laboratory equipment used to perform the tests and inspections is calibrated and controlled to assure accuracies consistent with specification requirements. All working standards are periodically certified, and are traceable to the National Bureau of Standards to the extent allowed by the Bureau's calibration facility. All factory test, measurement, and diagnostic equipment used, is controlled to the requirements of MIL-STD-45662.

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**WARNING**

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. As temporarily permitted by regulation it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

## THE CURE SERVICE

Scientific-Atlanta, Inc.'s CURE Service is a comprehensive approach to instrument maintenance available to all our customers. It is designed to completely restore an out-of-warranty instrument to its original specifications for a fixed charge.

When returning an instrument for repair, a request for CURE Service assures top instrument performance by performance by combining:

- Calibration
- Updating
- Repair
- Exchange as required

CURE Service is performed at the factory by qualified technicians who will optimize each internal adjustment, evaluate and incorporate all engineering design improvements, perform required repairs, exchange any defective or marginal components and modules, and thoroughly clean the instrument.

CURE Service includes a Calibration Certificate and a full 90-Day instrument warranty. All test equipment used in performing CURE Service is traceable to the National Bureau of Standards.

NOTE

Normally, this addendum would indicate that your instrument has been modified. The modifications listed in this addendum are now standard in all instruments. Therefore, this addendum should be viewed as a manual update.

8-21-79
Revised 10/29/81

# ADDENDUM
## Model SD345-4 Spectrascope® III

The Model SD345-4 is a modified Model SD345 Spectrascope® III. The standard Model SD345 User's Manual (Document No. 21146600) and Service Manual (Document No. 21202900), together with this addendum, provides coverage for the Model SD345-4.

The "-4" added to the basic model number indicates a modification that provides rear-panel GATED SWEEP TRIGGER/GATED Z AXIS (J11) and MEMORY SYNC (J12) outputs for compatibility with the following Spectral Dynamics' instruments:

Model SD25-80-1 3D DISPLAY CONTROL
Model 13151-21 SPECTROGRAM DISPLAY CONTROL
Model 13262 HARD COPY RECORDER
Model 13280 HARD COPY GRAM ADAPTER
Model 13389/TEK 4633A HARD COPY RECORDER

The modification was accomplished as follows:

a. On circuit card A7 (PWA 10487700), the connection between U51 pin 12 and pin B19 of the circuit card connector has been removed by cutting the clad at pin B19. Pin B19 has been connected to U50 pin 9. This changes the Display Request signal from 40.96 kHz to 20.48 kHz.

b. Circuitry has been added to the A12 circuit card (PWA 10497300) as shown in Figure 2. This figure replaces Sheet 4 of DWG. NO. 10497100.

c. Interconnections have been added as follows:

| | |
|---|---|
| A10-B28 to A12-B24 | $\overline{\text{EXECUTE}}$ |
| A12-B44 to A21-12 | MEM SYNC |
| A12-B12 to A21-4 | GATED SWEEP TRIG/ GATED Z AXIS |

d. The interconnections to the A21 card (BNC INTERFACE) connect the added circuitry to rear panel BNC connectors J11 and J12 as shown in Figure 2. This figure replaces DWG NO. 10487800. These connectors have been labeled as follows:

J11 GATED SWP TRIG Z AXIS
J12 MEM SYNC

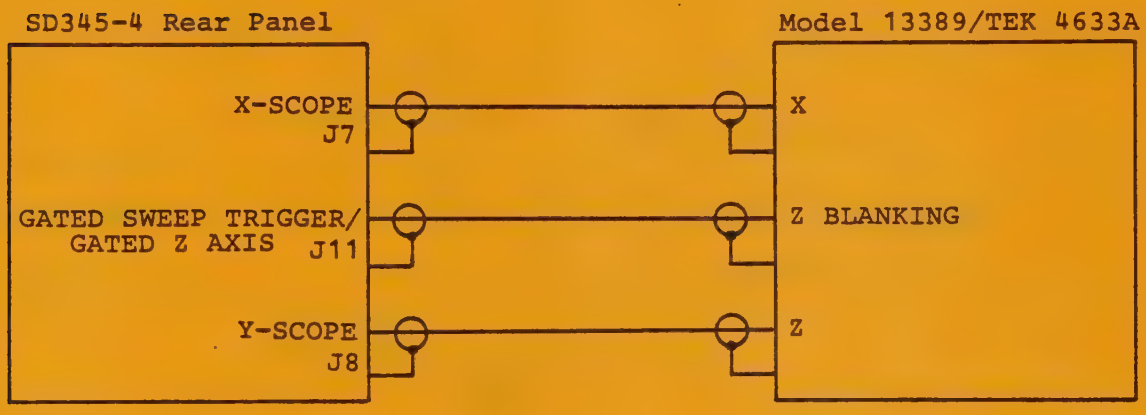



Figure 1. SD345-4 to Model 13389/TEK 4633A Interconnect

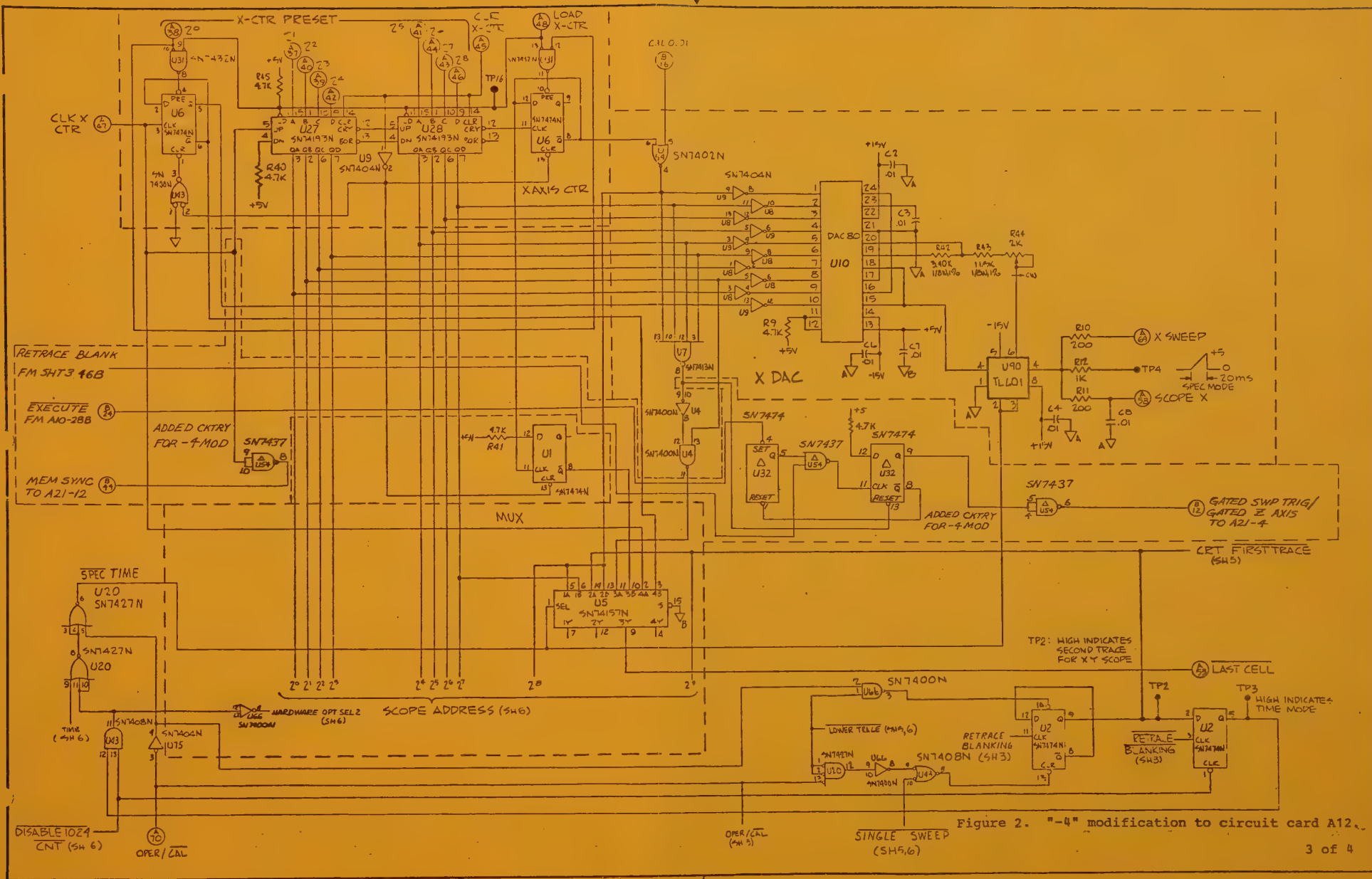



Figure 2. "-4" modification to circuit card A12.

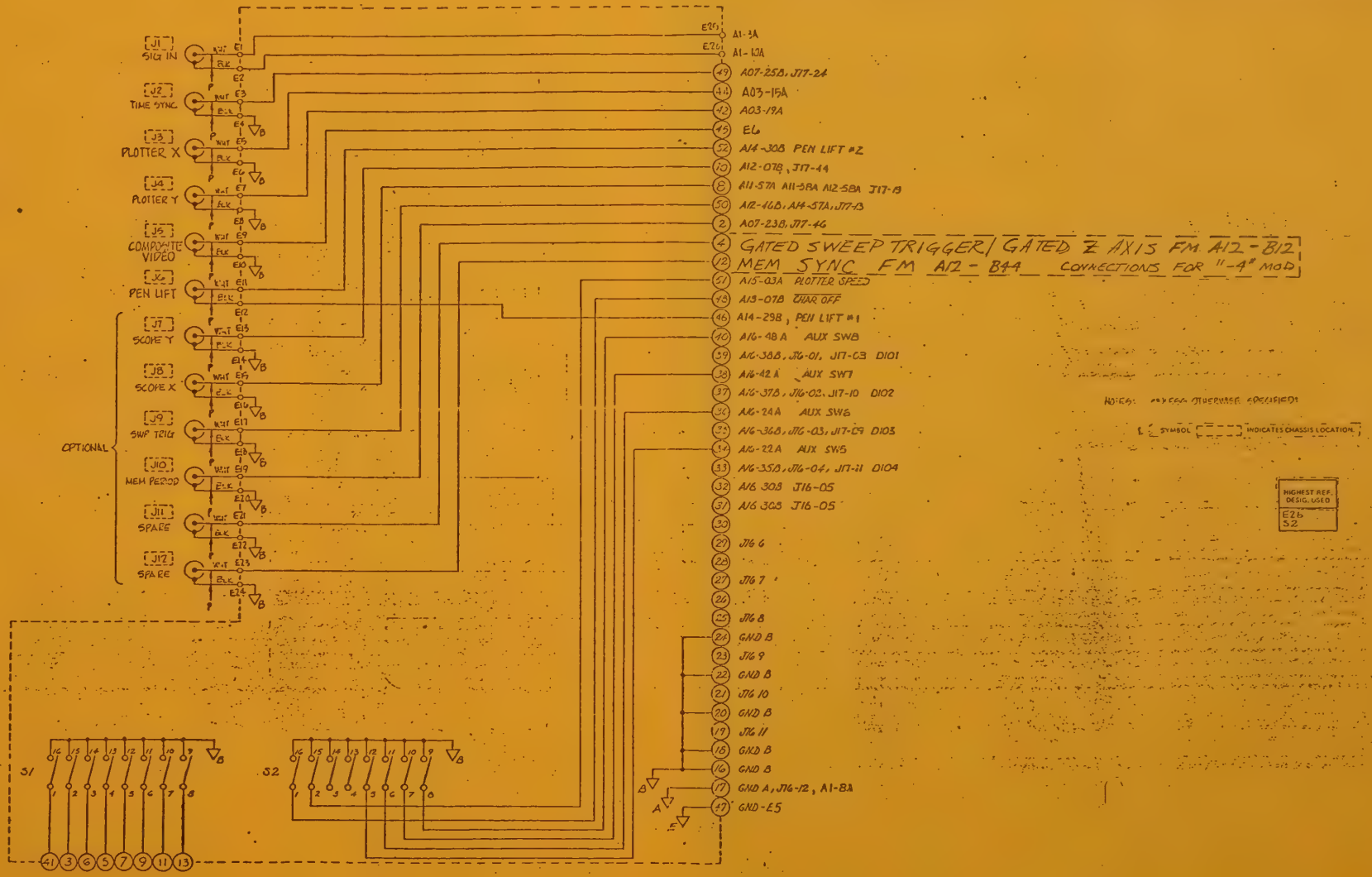



Figure 3. "-4" modification to circuit card A21.

## TABLE OF CONTENTS


| Section | | | Page |
|---|---|---|---|
| I | **GENERAL INFORMATION** | | |
| | 1.1 | Introduction | 1-1 |
| | 1.2 | Other Documentation | 1-1 |
| | 1.3 | Equipment Description | 1-1 |
| | 1.4 | Standard Features | 1-1 |
| | 1.5 | SD345 Option | 1-2 |
| | | 1.5.1 Digital Translator (-1 Option) | 1-2 |
| | | 1.5.2 1/3, 1/1 Octave Capability (-2 Option) | 1-2 |
| | | 1.5.3 Digital I/O System (-3 Option) | 1-2 |
| | 1.6 | SD345 Accessory Kit | 1-3 |
| | 1.7 | Ancillary Equipment | 1-3 |
| | 1.8 | Required Equipment | 1-3 |
| | 1.9 | Specifications | 1-3 |
| | | 1.9.1 Inputs | 1-3 |
| | | 1.9.2 Processing Parameters | 1-4 |
| | | 1.9.3 Analysis Characteristics | 1-4 |
| | | 1.9.4 Averager Characteristics | 1-4 |
| | | 1.9.5 Displays | 1-5 |
| | | 1.9.6 Output Characteristics | 1-5 |
| | | 1.9.7 Miscellaneous | 1-6 |
| | 1.10 | Replacement Parts | 1-7 |
| II | **INSTALLATION** | | |
| | 2.1 | Introduction | 2-1 |
| | 2.2 | Initial Inspection | 2-1 |
| | | 2.2.1 Unpacking | 2-1 |
| | | 2.2.2 Equipment Furnished | 2-1 |
| | | 2.2.3 Check for Physical Damage | 2-1 |
| | | 2.2.4 Reshipment Procedure | 2-1 |
| | | 2.2.5 Returned Equipment with Warranty or Damage Claims | 2-1 |
| | 2.3 | Safety Precautions | 2-1 |
| | | 2.3.1 Explosion Hazard | 2-1 |
| | | 2.3.2 Shock Hazard | 2-1 |
| | 2.4 | Preparation for Use | 2-2 |
| | | 2.4.1 Power Requirements | 2-2 |
| | | 2.4.2 Mounting | 2-2 |
| | | 2.4.3 Equipment Interconnections | 2-2 |
| III | **OPERATION** | | |
| | 3.1 | Introduction | 3-1 |
| | 3.2 | Front Panel Functional Description | 3-1 |
| | | 3.2.1 Input Group | 3-1 |
| | | 3.2.2 SENSITIVITY Group Keyboard | 3-3 |
| | | 3.2.3 Analysis Group | 3-4 |
| | | 3.2.4 TRANSLATOR Group (Standard Option) | 3-11 |


## TABLE OF CONTENTS (Continued)


| Section | | | Page |
|---|---|---|---|
| | | 3.2.5 CRT Group | 3-11 |
| | | 3.2.6 CURSOR Group | 3-12 |
| | | 3.2.7 PWR Push Button/Indicator | 3-14 |
| | 3.3 | Rear Panel Functional Description | 3-14 |
| | | 3.3.1 INPUT Group | 3-14 |
| | | 3.3.2 Output Group | 3-15 |
| | | 3.3.3 Miscellaneous Group | 3-15 |
| | | 3.3.4 Power Group | 3-18 |
| | 3.4 | Preliminary Powering | 3-18 |
| | 3.5 | Front Panel Control Familiarization | 3-19 |
| | | 3.5.1 Initial POWER ON Condition | 3-19 |
| | | 3.5.2 Display and Control Familiarization | 3-20 |
| | | 3.5.3 Display Combination Selection | 3-23 |
| | | 3.5.4 SENSITIVITY Selection | 3-25 |
| | | 3.5.5 CURSOR Group Functions | 3-27 |
| | | 3.5.6 Operational Notes | 3-29 |
| | 3.6 | Operational Checkout | 3-31 |
| | | 3.6.1 Setup | 3-31 |
| | | 3.6.2 Linearity Check | 3-32 |
| | | 3.6.3 Alphanumeric Display (Hz and KCPM) Check | 3-33 |
| | | 3.6.4 Alphanumeric Display (ORDERS) Check | 3-34 |
| | | 3.6.5 Alphanumeric Display (V) Check | 3-34 |
| | | 3.6.6 Alphanumeric Display (dB) Check | 3-35 |
| | | 3.6.7 Analysis Mode Check | 3-36 |
| | | 3.6.8 LIN Y-GAIN Check | 3-37 |
| | | 3.6.9 Time Mode Check | 3.37 |
| | | 3.6.10 Arithmetic Function (M1,2) Check | 3-37 |
| | 3.7 | Operator Maintenance | 3-38 |
| | | 3.7.1 Introduction | 3-38 |
| | | 3.7.2 Cleaning | 3-38 |
| | | 3.7.3 Operator Checks | 3-39 |
| IV | **CONCEPT OF OPERATION** | | |
| | 4.1 | General | 4-1 |
| | 4.2 | Concept of Operation | 4-1 |
| | | 4.2.1 Timing and Input Control | 4-1 |
| | | 4.2.2 Input Section | 4-2 |
| | | 4.2.3 Input Memory | 4-2 |
| | | 4.2.4 Microprogram Control Section | 4-2 |
| | | 4.2.5 CPU Section and Processor/ Averager Memories | 4-2 |
| | | 4.2.6 Output Control and Display Section | 4-3 |

## LIST OF ILLUSTRATIONS


| Figure | | Page |
|---|---|---|
| 2-1. | Low Line Voltage Toggle Switch and a Simplified Top View of the SD345 with the Cover Removed Showing the Location of the Toggle Switch | 2-2 |
| 3-1. | Model SD345 Front Panel | 3-1 |
| 3-2. | Model SD345 Rear Panel | 3-14 |
| 3-3. | Initial POWER ON Display | 3-19 |
| 3-4. | Front Panel Description of the Initial POWER ON Condition. LEDS with this Indication ☼ should be lighted during Initial POWER ON | 3-19 |
| 3-5. | CRT Alphanumerics and Related Front-Panel Controls | 3-20 |
| 3-6. | CRT Display Combinations and Controls | 3-23 |
| 3-7. | SENSITIVITY Group Touch Controls and Portions of the CRT Display | 3-25 |
| 3-8. | CURSOR Group Controls and Related Display Functions | 3-27 |
| 4-1. | SD345 Concept of Operation | 4-1 |
| 4-2. | Input Memory Organization | 4-2 |


## LIST OF TABLES


| Table | | Page |
|---|---|---|
| 1-1. | Special Replaceable Parts List, Printed Wiring Assemblies | 1-8 |
| 1-2. | Special Replaceable Parts List, PROMS | 1-9 |
| 1-3. | Special Replaceable Parts List, Integrated Circuits | 1-10 |
| 1-4. | Special Replaceable Parts List, Controls and Indicators | 1-11 |
| 3-1. | DIGITAL Connector (J16) Pin Assignments | 3-17 |
| 3-2. | SENSE & CONTROL Connector (J17) Pin Assignments | 3-17 |
| 3-3 | AUXILIARY Connector (J18) Pin Assignments | 3-18 |
| 3-4. | Description of Figure 3-5a, b & c | 3-21 |
| 3-5. | Equipment Required | 3-31 |
| 3-6. | GAIN Selection | 3-32 |
| 3-7. | Spectrum, Overall and ΔP Linearity | 3-32 |
| 3-8. | Alphanumeric Display Readings (HZ and KCPM) | 3-33 |
| 3-9. | Alphanumeric Display Readings (V) | 3-34 |
| 3-10. | Alphanumeric Display Readings (EU) | 3-35 |
| 3-11a,b | M1,2 Arithmetic Functions | 3-38 |

# SECTION I

# GENERAL INFORMATION

## 1.1 INTRODUCTION

This manual contains unpacking, initial checkout and operating instructions for the Spectral Dynamics SD345 FFT Analyzer. The manual is divided into four sections, each section covers a specific aspect of the instrument. This section contains a list of other documents available, a brief description of the instrument, ancillary equipment and options, accessories furnished and a replacement parts list.

The manual is written for the operator and contains no maintenance information other than that which can be performed without removing the covers or front panel. It is recommended that each section be read in its entirety before proceeding to the next section.

## 1.2 OTHER DOCUMENTATION

Spectral Dynamics produces two basic manuals for all equipments: A User's Manual, and a Service Manual. The User's Manual is shipped with each instrument; the Service Manual with engineering drawings can be ordered separately.

The Service Manual is available upon request. It contains detailed theory of operation, calibration procedures, maintenance information, parts lists, engineering drawings and wire lists. The manual is written for technical personnel with experience in analog and digital circuits. Manual contents will provide the maintenance technician with information guidelines to repair the instrument.

## 1.3 EQUIPMENT DESCRIPTION

The Model SD345 Micro FFT Analyzer is a stand-alone, hard wired instrument that combines a 400-line analyzer, ensemble averager, and a dual-trace raster scan crt in a single portable unit.

The instrument is a microprocessor-based FFT analyzer that analyzes frequencies up to 100 kHz with 400-line resolution.

Spectral data is displayed on the crt. Harmonic relationships (orders) between machine components can be directly displayed and any 25% of the display can be expanded to the full width of the crt for detailed examination. An alphanumeric readout on the crt, in conjunction with a cursor and the crt display grid, provides information in a variety of immediately usable forms. Quantities can be read out in engineering units (e.g., mil/sec, mil displacement, g). Automatically-scaled X-Y recorder outputs and X-Y display outputs are also provided.

The design of the SD345 adapts it to almost any application in the design, production testing, and maintenance troubleshooting of rotating machinery. In addition, since sound pressure level can be read out directly, it is useful in a broad variety of acoustic studies.

## 1.4 STANDARD FEATURES

The following features are provided as standard in the SD345:

- Front-panel selection of sixteen frequency ranges in 1, 2, 5 sequence from 1 Hz to 100 kHz full scale.

- A built-in dual-trace raster scan crt with cursor-controlled X4 magnification for expanding any selected 25% of the X axis spectrum for full screen viewing. A display grid which is internally generated by the Microprogram and projected on the crt to correspond with selected front-panel functions.

- A built-in averager for signal-to-noise enhancement in the frequency domain. Averaging can be performed on 2 through 1024 number of averages selected in binary sequence. The average number is updated at integer counts on the crt. Averaging in the LIN mode is performed linearly up to the selected number of averages and then stops.

  Averaging in the EXPO mode is performed linearly up to the selected number of averages and then continues exponentially, with a selected time constant, until terminated by the operator.

- A peak hold mode, which detects and retains the highest level in each of the 400 displayed cell locations. The peak values can be stored or erased by the operator.

- An alphanumeric readout on the raster scan crt gives a readout of the following parameters for any point on the spectrum display:

  a. Frequency in Hz

  b. Frequency in KCPM

  c. Harmonic order number relative to any selected fundamental.

  d. Amplitude Volts (rms), (P-P), (O-P)

  e. Amplitude dB

  f. Amplitude in EU

  g. $\Delta X$

  h. SEC

  i. Overall level in Vrms, dB and EU

  j. Time Mode Readout

  k. $\Delta P$

  l. PSD($EU^2$/Hz)

  Transducer sensitivity, dB REF and threshold percentage for transient capture are entered by means of a front-panel keyboard for direct engineering unit, relative dB readings or to capture transients exceeding a set threshold level in a positive or negative direction.

- A cursor that combines an intensified dot and a vertical line for locating specific spectral components.

- A harmonic cursor mode with fine tuning which intensifies all integer orders of the selected fundamental component.

- A SIMULPLOT feature which enables continuous viewing of the complete spectrum display of all 400 cells while plotting, plus:

  a. SIMULPLOT (with X-axis sweep rate feedback control). Two different plotter rates, (20 seconds and 40 seconds) can be selected from the rear panel.

  b. Interface to analog X-Y plotters with pen lift.

  c. Plot time waveform.

  d. Plot expanded display (X-axis X4 mode).

- A remote feature that provides the following lines for remote control OR'ed with front-panel control:

  a. START/STOP AVG

  b. Erase

  c. +1

  d. TRANS ARM

  e. MEMORY Hold/Update

  f. TRANSFER M1→M2

## 1.5 SD345 OPTIONS

The options described in the following subparagraphs are available for the SD345.

### 1.5.1 Digital Translator (-1 Option)

The -1 Option is the addition of three printed circuit assemblies PWA 21076600 location A5A4, PWA 21061300 location A5A5 and PWA 21052300 location A5A6. With the Digital Translator option the SD345 can now provide over 50 different zoom expansions for observing and analyzing signals which have frequency terms so close to each other that basic 400 line resolution analysis cannot separate them for proper identification. With the Digital Translator this resolution can be increased from 10 to 100.

### 1.5.2 1/3, 1/1 Octave Capability (-2 Option)

The -2 Option is the addition of one printed circuit assembly PWA 21138200 location A5A2. With the 1/3, 1/1 octave option the SD345 can provide 1/3 or 1/1 octave contiguous-band Spectrum Analysis.

### 1.5.3 Digital I/O System (-3 Option)

The -3 Option is the addition of one printed circuit assembly PWA 21185900 location A5A16. With the '-3' option the SD345 can provide IEEE 488 and RS232 interface for complete remote front-panel control and convenient output of digital data.

## 1.6 SD345 ACCESSORY KIT

The SD345 Accessory Kit consists of the following items:

1 SD345 User's Manual SDC P/N 21263000

1 Belden No. 17250 Power Cord

1 Extender Assembly SDC P/N 10499600

2 Rack Mounting Brackets (3½ ") SDC P/N 21145500

2 Rack Mounting Brackets (5¼ ") SDC P/N 21145600

1 Bail (Tilt Stand) SDC P/N 10570700

1 Extender Card SDC P/N 21010400

8 Phillips Oval Head Screws 10-32 × 3/8

## 1.7 ANCILLARY EQUIPMENT

Separate connectors are provided on the SD345 rear panel for an external raster scan display, an X-Y plotter and an X-Y display.

## 1.8 REQUIRED EQUIPMENT

An external sensing device is required to produce the input signal to be analyzed. This device may be any one of several types of dynamic motion, tape recording equipment, signal generators or audio measuring devices (transducers).

Depending upon the equipment being tested, the input transducer can be either an accelerometer, microphone, velocity pickup or displacement probe.

If the input device has an output impedance of other than 50 ohms, spurs will appear below 50 dB on the display with the 100 kHz analysis range selected and the 10 mV level selected.

## 1.9 SPECIFICATIONS

### 1.9.1 Inputs

Frequency Ranges

Standard (16 Ranges) . . . . . 1 Hz to 100 kHz as shown below:

| Upper Frequency Limit-Hz (KCPM) | | Resolution Hz (CPM) | | Time Window-Sec |
|---|---|---|---|---|
| 100k | (6000) | 250 | (15k) | 0.004 |
| 50k | (3000) | 125 | (7.5k) | 0.008 |
| 20k | (1200) | 50 | (3.0k) | 0.02 |
| 10k | (600) | 25 | (1.5k) | 0.04 |
| 5k | (300) | 12.5 | (750) | 0.08 |
| 2k | (120) | 5 | (300) | 0.2 |
| 1k | (60) | 2.5 | (150) | 0.4 |
| 500 | (30) | 1.25 | (75) | 0.8 |
| 200 | (12) | 0.50 | (30) | 2.0 |
| 100 | (6) | 0.25 | (15) | 4.0 |
| 50 | (3) | 0.125 | (7.5) | 8.0 |
| 20 | (1.2) | 0.05 | (3) | 20.0 |
| 10 | (0.6) | 0.025 | (1.5) | 40.0 |
| 5 | (0.3) | 0.0125 | (0.75) | 80.0 |
| 2 | (0.12) | 0.005 | (0.3) | 200.0 |
| 1 | (0.06) | 0.0025 | (0.15) | 400.0 |

Sensitivity (For full scale output) . . . . . Eleven full scale ranges from 10 mV to 20 V in 1, 2, 5 sequence. Selectable in rms, O-P, or P-P. Selectable Manual or Auto-ranging mode.

Absolute Maximum Input . . . . . 50 Vrms

Maximum Voltage, Input Low to Chassis Ground . . . . 1.5 Vrms

Transducer Sensitivities . . . . . Set by front-panel SENSITIVITY Group keyboard. 1 mV/EU to 99.9 mV/EU in 0.1 mV increments. 100 mV/EU to 999 mV/EU in 1.0 mV increments.

dB Reference Sensitivities . . . . . Set by the front-panel SENSITIVITY Group keyboard. 0 dB to 99.9 dB in 0.1 dB increments. 100 dB to 200 dB in 1.0 dB increments. (138 dB is maximum at 10mVrms input level; 204 dB maximum at 20 Vrms input level.)

Impedance . . . . . 100k ohms

Weighting . . . . . Acoustic A or C

Coupling . . . . . DC/AC (−3 dB at≈0.5 Hz; 50 mV Input Level and below AC coupling only).

Overload Indication . . . . . LED located on the LEVEL, VOLTS touch control for input overload. LED located on the Y, GAIN touch control for output overload.

### 1.9.2 Processing Parameters

Anti-Aliasing Filters . . . . . Automatically selected for each frequency range with initial 120 dB/octave roll-off for 70 dB rejection of aliasing terms; 1, 2, and 5 Hz frequency ranges utilize the 10 Hz lowpass antialiasing filter.

Sampling Rate ($f_s$) . . . . . 2.56 × full-scale frequency range selected on internal sampling control. External sampling control provided.

Transient Capture . . . . . a. Front-panel adjustable threshold.
b. Line threshold on crt display with readout.
c. Retains 10% of previous data when transients are loaded into memory.
d. Weighting in or out.

Weighting . . . . . Rectangular or Hanning, front-panel selectable.

### 1.9.3 Analysis Characteristics

Resolution . . . . . 400 lines of real time or averaged spectrum information on each analysis range. Processes a 1024 point transform.

Real Time Frequency . . . . . 3 kHz (Nominal)

Frequency Response . . . . . ±1 dB over the entire frequency range.

Dynamic Range . . . . . 65 dB typical with averaging from full scale to minimum discernible signal. The 50 kHz and 100 kHz frequency ranges with input levels of 50mV or below may have spurious frequency components below 50 dB. All other input levels and frequency ranges will have spurious components below 60 dB.

Average Noise Floor . . . . . 70 dB typical, with averaging; greater than 70 dB with noise subtraction.

Amplitude Linearity (Linear dynamic range)

Spectrum . . . . . ±0.05% of full scale or ±1.0 dB, whichever is greater.

Overall . . . . . ±1.0% of full scale or ±1.0 dB, whichever is greater.

### 1.9.4 Averager Characteristics

Calculation . . . . . True Power

Number of Averages . . . . . 2 through 1024 in binary sequence. Average number updated at integer counts on the crt.

Modes

LIN . . . . . Performs a linear average (ideal integrator) on a selected number of ensembles on a non-redundant basis until the selected number of ensembles has been reached.

EXPO . . . . . Performs a linear average (ideal integrator) on a selected number of ensembles on a non-redundant basis until the selected number of ensembles has been reached. Averaging then continues exponentially with a selected time constant.

The average process is indicated by a flashing LED and continues indefinitely until terminated by pushing the STOP touch control. Averaged information can be stored in memory until the next averaging is initiated.

PEAK ..... The highest level for each of the 400 lines and the overall signal is retained until exceeded. Information for all 400 filter locations is updated every 130 ms on all frequency ranges. Values can be stored or erased by using the front-panel AVG group ERASE and the XFER M1→M2 touch controls.

+1 MODE ..... Will function if either LIN, EXPO or PEAK is selected, provided the start mode is not initiated prior to selecting the +1 MODE. This mode will allow the user to step through each ensemble of the LIN, EXPO and PEAK modes as desired.

### 1.9.5 Displays

Built-in TV Raster Scan Display Continuous Amplitude Viewing Range ..... 70 dB

Display Rate ..... 65 sweeps per second

Display Modes

Spectrum ..... 400 lines of real-time or averaged spectrum information for each analysis range. X4 expansion (around cursor location) on the frequency axis for high reading resolution. Linear or logarithmic amplitude (Y axis) vs. linear frequency (X axis). RMS value of overall input signal displayed in cell locations 401 through 409. Grid is internally generated by the Microprogram and projected on the crt to correspond with selected front-panel functions. Alphanumerics are displayed simultaneously above and below projected grid display and correspond to read out units as selected by the front-panel controls. Dual display of the following functions is provided:

a. Time, Real Time

b. Time, M1

c. Time, M2

d. Real Time, M1

e. M1, M2

f. Real Time, M2

Time ..... Input signal displayed as a function of time. 512 points (every other point) of the 1024 points processed for the FFT is displayed as a function of time.

### 1.9.6 Output Characteristics

X-Y Recorder ..... Features SIMULPLOT(continuous CRT display during PLOT mode) and Sweep rate feedback plotting with two selectable plotting rates; X, Y, and pen-lift output. Plots contents of input memory or expanded part of input memory as selected by X axis LIN X4 mode. Plots single or dual trace displays. Plots contents of M2 while averaging data in M1.

Amplitude (Y axis) ..... Linear 0-5 Vdc (Nominal) Log 0-5 Vdc (70 dB).

Frequency (X axis) . . . . . Linear 0-5 Vdc (Nominal) Log −0.6 Vdc to +5 Vdc (Nominal) 2 V per decade.

dB REF . . . . . Amplitude of any component selected by the cursor can be set to 0 dB or to any positive value up to 200 dB (138 dB is maximum at 10 mVrms input level. 204 dB is maximum at 20 Vrms input level).

Internal Calibration . . . . . Internally generated square wave is available by depressing the front-panel SIGNAL group TEST touch control. The fundamental is −10 dB from full scale and is located at cell 256 for all frequency ranges. This signal can be used for operational check-out of the instrument. Other frequency components may appear on the 100 kHz frequency range with the test signal.

Display Calibration

Y Axis . . . . . Log: Full scale and −40 dB selectable.

Lin: Full scale and linear zero selectable.

Log: Full scale and −2 decade selectable.

X Y Recorder Simulplot . . . Data is displayed continuously on the crt while plotting. An intensified dot with a vertical line moves across the spectrum automatically to indicate the position on the plotter. Two plotter rates, 20 and 40 seconds, can be selected from the rear panel. Plotter sweep rate control is furnished for automatic slowdown during recording of data peaks.

External CRT (Raster Scan) Outputs (Composite video)

Amplitude (Y Axis) . . . . . Linear X1, X2, X5, X10 Log −30 dB to +30 dB in 10 dB steps.

Frequency (X Axis) . . . . . Linear X1, X4 Log X

Retrace Blanking . . . . . Positive TTL

Display

Amplitude (Y Axis) . . . . . Linear X1, X2, X5, X10 Log −30 dB to +30 dB in 10 dB steps.

Frequency (X Axis) . . . . . Linear X1, X4 Log X

Output Overload Indicator . . . . . LED located on the Y GAIN increase touch control upper left hand corner. An output overload will be indicated by the LED being lit constantly.

### 1.9.7 Miscellaneous

Intensity Mark (Cursor)

Normal . . . . . Can be moved left or right at a preselected rate or can be stopped to locate on any desired component of real-time or averaged data. A vertical line also appears when the cursor is moved.

Harmonic . . . . . Intensified dot placed automatically at all integer harmonics of selected fundamental. Fine resolution of 1/256 is available at a fundamental location to align higher order harmonics. Harmonics can be frozen and a line cursor can then

be moved to any harmonic for direct amplitude and order readout on the alpha-numeric display on the crt.

External Inputs (Rear Panel)

SIG IN ..... Performs the same function as the INPUT BNC connector located at the lower right-hand corner of the front panel.

TIME SYNC ..... Accepts TTL level input as trigger reference for time-domain signal averaging or synchronous spectrum functions.

Dimensions

Height ..... 22,2 cm (8.75")

Width ..... 43,2 cm (17")

Depth ..... 48,6 cm (19")

Weight ..... 22,68 Kg (50 lbs.) Nominal

Temperature Range ..... 5°C to 45°C (40°F to 113°F)

Power ..... 105-125/210-250 Vac (90 to 121 Vac for Japan), 47-65 Hz, at ≈400 watts.

## 1.10 REPLACEMENT PARTS

Except for some special SDC specification controlled parts listed in Tables 1-1 through 1-4, standard electronic parts are used in the Model SD345 circuitry. To aid in replacement some miscellaneous parts are also listed. Spectral Dynamics maintains a stock of parts used in this instrument.

When ordering parts, include assembly number of card reference designation, description, and SDC part number. Also include the instrument serial number and complete model number including "dash" number.

**Table 1-1. Special Replaceable Parts List, Printed Wiring Assemblies.**

| Reference Designator | Description | Part No. |
|---|---|---|
| A1 | Main Frame Assy. | 10498000 |
| A1A1 | Mother Board Assembly | 10491400 |
| A1A2 | Chassis Assembly | 21077600 |
| A2 | Front Panel Assembly | 21026000 |
| A3 | CRT Assembly | 21014400 |
| A4 | Rear Panel Assembly | 21018800 |
| A5 | PWA Set | 10482200 |
| A5A1 | Low Pass Filter Assembly | 21082100 |
| A5A2 | 1/3 Octave Assembly (Option) | 21138200 |
| A5A3 | A/D Converter Assembly | 21085100 |
| A5A4 | Translator Assembly (Option) | 21076600 |
| A5A5 | Translator Assembly (Option) | 21061300 |
| A5A6 | Translator Assembly (Option) | 21052300 |
| A5A7 | Input Memory and Timing Assembly | 10487700 |
| A5A8 | Processor Memory Assembly | 10488900 |
| A5A9 | Multiplier Assembly | 10479200 |
| A5A10 | Microprogram Control Assembly | 21196500 |
| A5A11 | Central Processor Assembly | 10483200 |
| A5A12 | Refresh Memory Assembly | 10497300 |
| A5A13 | Video Interface Assembly | 10492500 |
| A5A14 | Display Control Assembly | 10486300 |
| A5A15 | Memory Address Assembly | 10481500 |
| A5A16 | Digital I/O System Assembly (Option) | 21185900 |
| A5A18 | Front Panel Interface Assembly | 21014700 |
| A5A19 | Front Panel Control Assembly | 21069100 |
| A5A20 | TV Signal Transfer Assembly | 21081800 |
| PS1 | Power Supply Assembly | 21025100 |
| PS1A1 | Regulator Assembly | 21025300 |
| PS1A2 | Inverter Assembly | 21025500 |
| PS1A3 | Power Panel Assembly | 21047000 |

## Table 1-2. Special Replaceable Parts List, PROMS.

| Reference Designator | Description | Part No. |
|---|---|---|
| A5A1U29 | IC,PROM(AR) | 21135800 |
| A5A1U32 | IC,PROM(LEVEL) | 21135900 |
| A5A7U24 | IC,PROM(INP1) | 21150000 |
| A5A7U25 | IC,PROM(INP2) | 21150100 |
| A5A8U9 | IC,PROM(MCXB9-1) | 21172800 |
| A5A8U11 | IC,PROM(MCXB9-2) | 21172900 |
| A5A8U13 | IC,PROM(MCXB9-3 | 21173000 |
| A5A8U8 | IC,PROM(MCXB10-1) | 21173100 |
| A5A8U10 | IC,PROM(MCXB10-2) | 21173200 |
| A5A8U12 | IC,PROM(MCXB10-3) | 21173300 |
| A5A10U21 | IC,PROM(MCXB1-1) | 10493200 |
| A5A10U22 | IC,PROM(MCXB1-2) | 10493400 |
| A5A10U23 | IC,PROM(MCXB1-3) | 10493600 |
| A5A10U30 | IC,PROM(MCXB2-1) | 10493300 |
| A5A10U31 | IC,PROM(MCXB2-2) | 10493500 |
| A5A10U32 | IC,PROM(MCXB2-3) | 10493700 |
| A5A10U41 | IC,PROM(MCXB3-1) | 10493800 |
| A5A10U42 | IC,PROM(MCXB3-2) | 10494000 |
| A5A10U43 | IC,PROM(MCXB3-3) | 10494200 |
| A5A10U52 | IC,PROM(MCXB4-1) | 10493900 |
| A5A10U53 | IC,PROM(MCXB4-2) | 10494100 |
| A5A10U54 | IC,PROM(MCXB4-3) | 10494300 |
| A5A10U1 | IC,PROM(MCXB5-1) | 10494400 |
| A5A10U2 | IC,PROM(MCXB5-2) | 10494600 |
| A5A10U3 | IC,PROM(MCXB5-3) | 10494800 |
| A5A10U5 | IC,PROM(MCXB6-1) | 10494500 |
| A5A10U6 | IC,PROM(MCXB6-2) | 10494700 |
| A5A10U7 | IC,PROM(MCXB6-3) | 10494900 |

| Reference Designator | Description | Part No. |
|---|---|---|
| A5A10U9 | IC,PROM(MCXB7-1) | 10495000 |
| A5A10U10 | IC,PROM(MCXB7-2) | 10495200 |
| A5A10U11 | IC,PROM(MCXB7-3) | 10495400 |
| A5A10U14 | IC,PROM(MCXB8-1) | 10495100 |
| A5A10U15 | IC,PROM(MCXB8-2) | 10495300 |
| A5A10U16 | IC,PROM(MCXB8-3) | 10495500 |
| A5A12U47 | IC,PROM(MSQ1) | 21082900 |
| A5A12U70 | IC,PROM(MSQ2) | 21082800 |
| A5A12U50 | IC,PROM(MSIN1) | 21083100 |
| A5A12U73 | IC,PROM(MSIN2) | 21083000 |
| A5A12U49 | IC,PROM(MCOS1) | 21083300 |
| A5A12U72 | IC,PROM(MCOS2) | 21083200 |
| A5A12U48 | IC,PROM(LOGX1) | 21134400 |
| A5A12U71 | IC,PROM(LOGX2) | 21134500 |
| A5A12U19 | IC,PROM(TVXFR) | 21133500 |
| A5A13U17 | IC,PROM(DET) | 21135000 |
| A5A13U28 | IC,PROM(TXA) | 21134900 |
| A5A13U31 | IC,PROM(TYA) | 21135400 |
| A5A13U51 | IC,PROM(Y-LINE) | 21135200 |
| A5A13U71 | IC,PROM(X-LINE) | 21135100 |
| A5A13U73 | IC,PROM(Y-INST) | 21135300 |
| A5A14U36 | IC,PROM(RFSH1) | 21132800 |
| A5A14U37 | IC,PROM(RFSH2) | 21132900 |
| | | (INTEL) (TI) |
| A5A19U38 | *IC,PROM(Z80MCX1) | 21170000/21135500 |
| A5A19U39 | *IC,PROM(Z80MCX2) | 21170100/21135600 |
| A5A19U40 | *IC,PROM(Z80MCX3) | 21170200/21135700 |

*Before ordering this part, ascertain the proper manufacturer of the IC in your instrument and use the part number in the corresponding column. Since the pin configurations are different, these parts are not interchangeable.

**Table 1-3. Special Replaceable Parts List, Integrated Circuits.**

| Reference Designator | Description | Part No. |
|---|---|---|
| A5A1U1,11,37,38 | IC, Operational Amplifier, JFET Input, Precision Monolithics Part No. OP-16E | 21156600 |
| A5A1U2-4,13,16-19,33-36 | IC, Operational Amplifier, Buffered JFET Input, National Part No. LF356N. | 10674901 |
| A5A1U5-10,21-18 | *IC, CMOS, Triple 2-Channel Analog Multiplexer, RCA Part No. CD4053BF. | 10705100 |
| A5A1U14,39 | IC, Quad Comparator, Motorola Part No. LM339N. | 10656400 |
| A5A1U20 | *IC, CMOS, Multiplexer/Demultiplexer, Single 8-Channel with Logic Level Conversion, Fairchild Part No. 4051PC. | 10627400 |
| A5A3U1 | IC, A/D Converter, Ultra High Speed, Computer Labs Part No. MAS 1001-3-C2SC. | 10707800 |
| A5A3U2,11-13 | IC, Operational Amplifier, Voltage Follower, National Part No. LM310N. | 10667200 |
| A5A3U3-9,14-17,19,20 | IC, Operational Amplifier, High Speed, National Part No. LM318N. | 10667300 |
| A5A3U10 | *IC, CMOS, Quad Bilateral Switch, Fairchild Part No. 4066PC. | 10615500 |
| A5A3U18 | IC, Quad Comparator, Motorola Part No. LM339N. | 10656400 |
| A5A3U21 | IC, Timer, Intersil Part No. NE555V. | 10535501 |
| A5A3U23 | IC, Operational Amplifier, National Part No. LM301AN | 10666400 |
| A5A3U25 | IC, Operational Amplifier, Frequency Compensated, National Part No. LM741CN. | 10670000 |
| A5A3U36 | *IC, PMOS, Analog Switch, Texas Instruments Part No. TL601CD. | 10688101 |
| A5A3U37 | IC, Operational Amplifier, Buffered JFET Input, National Part No. LF356N. | 10674901 |
| A5AU44-49,60-65 | IC, 1 X 1024 Bit Random Access Memory, Synertek Part No. SYP21L02A. | 10587301 |
| A5A8U19-27,38-41,56-58 | IC, Random Access Memory, (1]24 X 4), Intel Part No. P2114-3. | 10692900 |
| A5A8U52-55 | IC, Tri-State Quad Bus Transceivers Signetics Part No. N8T28B. | 10662100 |
| A5A9U17,18,27,28,36,37 | IC, 2's complement Multiplier (4 X 2), Fairchild Part No. F93S43PC. | 10594802 |
| A5A11U24-30 | IC, Central Processing Element, Signetics Part No. N3002N. | 10672500 |
| A5A12U10 | IC, D/A Converter, Burr Brown Part No. DAC80-CBI-V. | 10663900 |
| A5A12U11 | IC, 8-Bit Multiplexing D/A Converter, Motorola Part No. MC1408L. | 10675800 |
| A5A12U13 | IC, Dual Operational Amplifier, RCA Part No. CA1458G. | 10514001 |
| A5A12U55-65,78,89 | IC, 1 X 1024 Bit Random Access Memory, Synertek Part No. SYP21L02A. | 10587301 |
| A5A12U90 | *IC, PMOS, Analog Switch, Texas Instruments Part No. TL601CD. | 10688101 |
| A5A13U66,68 | IC, Random Access Memory (1024 X 4), Intel Part No. P2114-3 | 10692900 |
| A5A13U77,86 | IC, Random Access Memory, (1K X 1) Signetics Part No. N82S11N. | 10702400 |
| A5A13U101 | IC, Operational Amplifier, National Part No. LH0002CH. | 10587200 |
| A5A13U102 | IC, General Purpose Transistor Array, RCA Part No. CA3046. | 10516300 |
| A5A13U105 | IC, Read Only Memory, Character Generator, 64 Character, National Part No. DM8678 BWFN. | 10713000 |
| A5A18U34,35 | *IC, CMOS, Random Access Memory (512 X 4), 270 ns, Harris Part No. Part No. HM3-6513L-9. | 10710500 |
| A5A18U37 | IC, Microprocessor, Zilog, Part No. Z80-CPU. | 10704200 |
| A5A18U38,39 | IC, Tri-State Quad Bus Transceivers, Signetics Part No. N8T28B. | 10662100 |
| A5A18U64,65 | IC, Random Access Memory, (1K, 256 X 4) Fairchild Part No. 93422DC. | 10703200 |
| PS1A1U1 | IC, Positive Voltage Regulator, Adjustable, +12 to +37 Volts, National Part No. LM317K. | 10680901 |
| PS1A1U2 | IC, Positive Adjustable Voltage Regulator, Fairchild Part No. uA78GKC. | 10661603 |
| PS1A1U3 | IC, Negative Voltage Regulator, Adjustable, -1.2 to -3.7 Volts, National Part No. LM337K. | 10721100 |
| PS1A2U1 | IC, Operational Amplifier, High Speed, National Part No. LM318N. | 10667300 |
| PS1A2U2 | IC, Precision Voltage Regulator, 2-37V, Fairchild Part No. uA723DC. | 10511001 |
| PS1A2U3 | IC, Positive 12VDC Voltage Regulator, Motorola Part No. MC7812KC. | 10643000 |
| PS1A2U4 | *IC, CMOS, Buffered Quad 2-Input NOR Gate, Fairchild Part No. 4001BDC. | 10606600 |
| PS1A2U5 | *IC, CMOS, Buffered Quad 2-Input NAND Gate, Fairchild Part No. 4011PC. | 10622600 |
| PS1A2U6 | *IC, CMOS, Dual Flip-Flop with Set/Reset, Fairchild Part No. 4013PC. | 10589000 |
| PS1A2U7 | *IC, Voltage Comparator, Fairchild Part No. LM311H. | 10514500 |

*These IC's are highly susceptible to damage from electrostatic charges. Any time the MOS IC is not in the circuit, special handling is required. Upon removal from the shipping container or the circuit, the IC should be placed in special conductive foam if available. If not, any material such as tin foil should be used to short the IC pins together when the IC is not in the circuit.

**Table 1-4. Special Replaceable Parts List, Controls and Indicators.**

| Reference Designator | Description | Part No. |
|---|---|---|
| A1 | Cable/Switch Assembly, Power ON/OFF | 10453500 |
| A1R1 | Potentiometer, Panel Mounted, 5K ohms, (contrast) Allen Bradley Part No. WA1G040P502VA. | 10548501 |
| A1R2 | Potentiometer, Panel Mounted, 10K ohms (Grid) Allen Bradley Part No. WA2G040S103UA. | 10548521 |
| A1A21S1,2 | Switch, Dual In-Line, 8 position, SPST, Amp Part No. 435166-5 | 10604701 |
| A3 | Monitor, Video, 5" CRT Data Display, Ball Bros. Part No. Model TV-50 (P-39 Phosphor). | 10713301 |
| A3 | Knob, Rogan Part No. RB-67-O-M-3501 1/8" Round Shaft. | 10714400 |
| A5A1K1,3-9 | Relay, 12V, 500 ohms Coil Resistance, Elec-Trol Part No. RA30381121. | 10610901 |
| A5A1K2 | Relay, Dual In-Line, 5V, 200 ohms Coil Resistance, Elec-Trol Part No. RA30421121. | 10631702 |
| A5A1R19 | Potentiometer, 5K ohms Beckman Part No. 72XR5K. | 10648200 |
| A5A1R33,66,71,81,97, 124,134,149 | Potentiometer, 500 ohms, Beckman Part No. 72PR500. | 10648302 |
| A5A1R34,56,58 | Potentiometer, 100K ohms, Beckman Part No. 72PR100K. | 10648310 |
| A5A1R48,68,95,121,147 | Potentiometer, 1K ohm, Beckman Part No. 72PR1K. | 10648303 |
| A5A1R49 | Potentiometer, 2K ohms, Beckman Part No. 72PR2K. | 10648304 |
| A5A1R53 | Potentiometer 10K ohms, Beckman Part No. 72PR10K. | 10648306 |
| A5A1R92 | Potentiometer, 200 ohms, Beckman Part No. 72PR200. | 10648301 |
| A5A1R119 | Potentiometer, 100 ohms, Beckman Part No. 72PR100. | 10648309 |
| A5A3K1 | Relay, Dual In-Line, 5V, 200 ohms Coil Resistance, Elec-Trol Part No. RA30421121. | 10631702 |
| A5A3R2,15,27,35 | Potentiometer, Trimmer, 1K ohm, Beckman Part No. 66WR1K. | 10544305 |
| A5A3R5,56 | Potentiometer, Trimmer, 2K ohms, Beckman Part No. 66WR2K. | 10544306 |
| A5A3R13,24,108,116 | Potentiometer, Trimmer, 500 ohms, Beckman Part No. 66WR500. | 10544304 |
| A5A3R50 | Potentiometer, Trimmer, 100K ohms, Beckman Part No. 66WR100K. | 10544312 |
| A5A3R51 | Potentiometer, Trimmer, 5K ohms, Beckman Part No. 55WR5K. | 10544307 |
| A5A3R121 | Potentiometer, Trimmer, 25K ohms, Beckman Part No. 66WR25K. | 10544310 |
| A5A3R127 | Potentiometer, Trimmer, 10K ohms, Beckman Part No. 66WR10K. | 10544308 |
| A5A7S1 | Switch, SPDT (Sine/Dither) C & K Components Part No. 7101A. | 10531800 |
| A5A7R25 | Potentiometer, 100 ohms, Beckman Part No. 72XR100. | 10648204 |
| A5A12R18 | Potentiometer, 100K ohms, Beckman Part No. 72XR100K. | 10648205 |
| A5A12R4 | Potentiometer, 2K ohms, Beckman Part No. 72XR2K. | 10648208 |
| A5A12R19 | Potentiometer, 1K ohm, Beckman Part No. 72XR1K. | 10648206 |
| A5A13Q2 | Transistor, MOS FET, Enhancement, Signetics Part No. SD211. | 10649500 |
| A5A13R23,25 | Potentiometer, Trimmer, 5K ohms, Beckman Part No. 62PR5K. | 10544110 |
| A5A14K1 | Relay, 5V, 500 ohms Coil Resistance, Teledyne Part No. 712-5 | 10526800 |
| A5A19DS1 | Audio Indicator, 3-16 Volt, Projects Unlimited Part No. A1-254. | 10713201 |
| A4A19R2 | Potentiometer, 500 ohms, Beckman Part No. 72XR500. | 10648201 |
| A5A20R1 | Potentiometer, Trimmer, 100K ohms, Beckman Part No. 89PR100K. | 10544713 |
| PS1A1A1 | Rectifier Assembly | 21045600 |
| PS1A1S1 | Switch, SPDT, (Low Line Voltage) C & K Components Part No. 7101AQ | 10531807 |
| PS1A1R2 | Potentiometer, 500 ohms, Beckman Part No. 72XR500. | 10648201 |
| PS1A1R5 | Potentiometer, 5K ohms, Beckman Part No. 72XR5K. | 10648200 |
| PS1A1R8 | Potentiometer, 20 ohms, Beckman Part No. 72XR20. | 10648209 |
| PS1A2Q1,2 | Transistor, RCA Part No. 2N6674 | 10727500 |
| PS1A2DS1 | Protector, Voltage Surge, Siemens Part No. B1-A230. | 10620300 |
| PS1A2DS2 | Lamp, Neon, Chicago Miniature Part No. A1A. | 10614900 |
| PS1A2RT1,2 | Thermistor, 5 ohms, 0.09 ohms with a Maximum Current of 7 Amps, Rodan Part No. SD-6. | 10696900 |
| PS1A2BT1 | Battery, 2.4VDC, 0.07AH, General Electric Part No. 41B901 BD11-G1. | 10710400 |
| PS1A2CR4 | LED, Solid State Red-Clear, Monsanto Part No. MV5022. | 10535600 |
| PS1A2R7,13 | Potentiometer, 10K ohms, Beckman Part No. 72XR10K. | 10648202 |
| PS1A2CR19 | Rectifier, Single-Phase, Full Wave, Motorola Part No. MDA201. | 10502603 |
| PS1A3CR1 | Rectifier, Single-Phase, Full Wave 25 Amp, 400 Volt, General Instruments Part No. KBPC2504. | 10612603 |
| PS1A3S1,2 | Switch, Slide, Voltage Selector, DPDT Locking, Switchcraft Part No. 46256LFR. | 10528600 |
| PS1A3XF1 | Fuseholder, Littlefuse Part No. 34-2001A. | 10637501 |

## SECTION II

## INSTALLATION

### 2.1 INTRODUCTION

This section contains instructions for performing an initial inspection of the Model SD345 FFT Analyzer. Installation procedures and precautions are presented in step-by-step order. The procedures for making a claim for warranty repairs and for repacking the instrument for shipment are also described in this section.

### 2.2 INITIAL INSPECTION

The instrument was inspected mechanically and electrically before shipment. Upon receipt, inspect it for damage that may have occurred in transit. Check for broken knobs, bent or broken connectors and dents or scratches. If damage is found, refer to the claims paragraph in this section.

#### 2.2.1 Unpacking

Use care in removing the instrument from its shipping container to prevent damage to the front and rear panel controls and connectors. Save the shipping container and all packing material until the instrument has been inspected and checked for operation.

#### 2.2.2 Equipment Furnished

Check to insure that each item on the packing slip is included with the shipment. Accessory kits may be shipped in separate containers and each item should be inspected for damage.

#### 2.2.3 Check for Physical Damage

Inspect all panels for dents, signs of chipped paint or scratches. Check for broken or bent connectors, switches and broken knobs. If there is damage, photos of the damage may be helpful in any subsequent claims.

#### 2.2.4 Reshipment Procedure

If the Model SD345 is to be shipped after receipt, use the original shipping container and packing material. If original packing material is not available, materials for reshipment normally include the following:

a. A double wall carton with a test strength of 350 pounds. Carton size should be such that the packing material listed below can be used.

b. Heavy paper or sheets of cardboard to protect all surfaces.

c. Nonabrasive material such as polyurethane or cushioned paper between projecting parts and wall of carton.

d. At least 4 inches of shock absorbing material such as extra-firm polyurethane.

#### 2.2.5 Returned Equipment with Warranty or Damage Claims

If the SD345 is found to be damaged in transit or does not operate as specified when received, notify the carrier and the nearest Spectral Dynamics sales/service office or representative immediately. Spectral Dynamics' sales/services offices and representatives are listed at the back of this manual. The local office will arrange for repair or replacement. Be sure to attach a card showing the owner's name, address, telephone number and a description of the service required.

### 2.3 SAFETY PRECAUTIONS

**WARNING**

Read the following safety precautions before attempting to operate this instrument.

The Model SD345 FFT Analyzer presents no hazard to operating personnel if operated in accordance with the instructions in this manual.

#### 2.3.1 Explosion Hazard

Do not operate the SD345 in any environment where flammable vapors may exist. Operation of any electrical instrument in such an environment constitutes a definite explosion hazard.

#### 2.3.2 Shock Hazard

When connected to a three-contact power receptacle, the three conductor ac power cable supplied with the

SD345 grounds the panel and chassis. This grounding protects the operator from possible injury. To preserve this protection when operating from a two conductor outlet, use a three-conductor to two-conductor adapter and connect the adapter wire to ground at the power outlet before connecting the instrument. Covers and safety plates should be removed *only* by *qualified* maintenance personnel. Voltages are present inside this instrument whenever the power cord is connected even when the power switch is off.

## 2.4 PREPARATION FOR USE

### 2.4.1 Power Requirements

The SD345 FFT Analyzer is designed to operate on either 115 Vac or 230 Vac. Therefore, before applying power to the instrument check the following:

a. There are two transformer slide switches located on the rear panel labeled S1 and S2. Both switches must be in the 115 Vac or the 230 Vac position.

b. The fuse in fuse holder F1 should be a 10A SLO-BLO for both 115 Vac and 230 Vac.

c. For operation in Japan or low line voltage operation, there is a toggle switch located in the power supply (Refer to Figure 2-1). For normal operation with both rear-panel slide switches either in the 115 Vac or 230 Vac positions, the toggle switch must be in the 120 V position. For operation in Japan the rear-panel slide switches must be in the 115 Vac position and the toggle switch must be in the 100/110V position. If low line voltage is experienced in countries other than Japan, this toggle switch can be utilized in the 100/110V position even if both rear-panel slide switches are in the 230 Vac position.

**CAUTION**

Removal of the top cover of the SD345 is required for access to the low line voltage switch. Prior to removing the cover, insure that power to the instrument is turned off and the power cord is unplugged. After the cover is removed, do not touch any components in the power supply assembly or the crt assembly other than the low line voltage toggle switch.

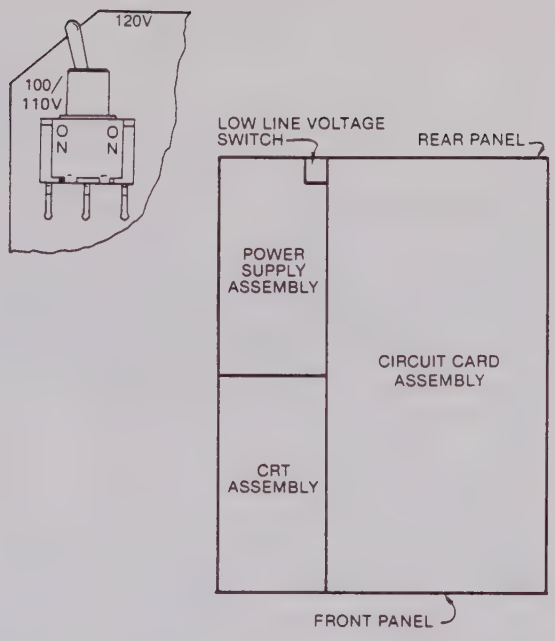



**Figure 2-1. Low line voltage toggle switch and a simplified top view of the SD345 with the cover removed showing the location of the toggle switch.**

### 2.4.2 Mounting

The SD345 is shipped from the factory as a bench instrument with bail (tilt stand) and trim in place. If rack mounting is required, rack mounting hardware is provided as part of the accessory kit and must be attached before mounting in the rack.

**CAUTION**

1. The SD345 requires at least 1-3/4" open space above the top cover and at least 4" open space behind the rear-panel fan for proper cooling.

2. To prevent damage to the cooling fan, never set the instrument on its rear panel.

### 2.4.3 Equipment Interconnections

The Model SD345 is self-contained requiring only an analog input signal to function. However, external signals are provided at the rear panel for an external X-Y plotter, an external X-Y display and an external raster scan display. Optional interconnects are also available as described in section III paragraph 3.3.

## SECTION III

## OPERATION

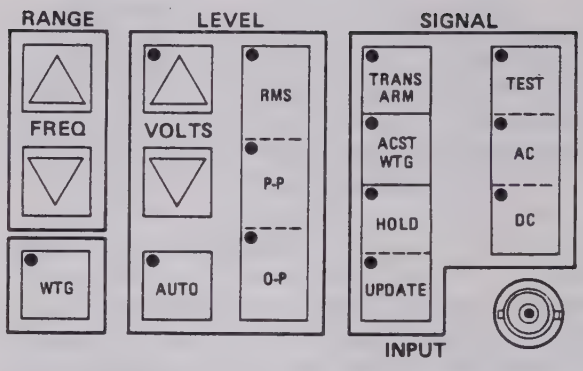
### 3.1 INTRODUCTION

This section provides the operator with a description of all controls and indicators, initial setup and adjustments, operational checkout and instrument operation including operator maintenance.

### 3.2 FRONT PANEL FUNCTIONAL DESCRIPTION

Figure 3-1 is a front view of the SD345. The front-panel controls, indicators and connectors are arranged into groups according to the functions performed. The following paragraphs describe the functions performed by each group and each control. Each group is separately illustrated to facilitate the description.

#### 3.2.1 Input Group




**INPUT BNC Connector**

Accepts the input analog data signal for analysis.

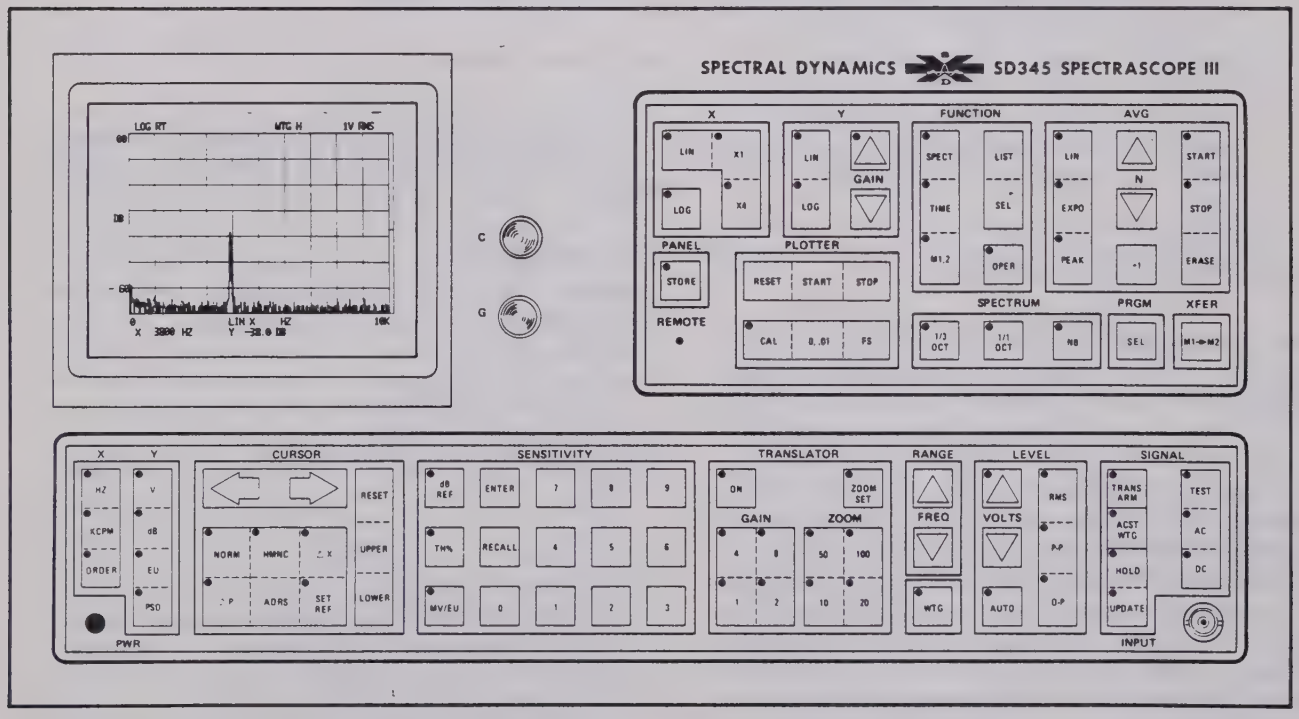



**Figure 3-1. Model SD345 Front Panel.**

### RANGE (FREQ) Touch Controls

Selects the analysis frequency range for the input data signal (upper frequency limit) in sixteen ranges in 1, 2, 5, sequence as follows: 1 Hz, 2 Hz, 5 Hz, (with a 10 Hz LPF) 10 Hz, 20 Hz, 50 Hz, 100 Hz, 200 Hz, 500 Hz, 1 kHz, 2 kHz, 5 kHz, 10 kHz, 20 kHz, 50 kHz, and 100 kHz. The frequency selected will appear as an alphanumeric on the crt. When operating in frequency ranges 20 Hz and below, aliasing terms from the sine dither square wave may be present on the display. These aliasing terms can be eliminated by placing the sine dither switch in the OUT position. The sine dither switch is a toggle switch located on the A7 circuit card. Viewing the component side of the circuit card, the sine dither switch can be located either on the upper right-hand corner of the card or towards the upper left-hand corner of the card. In some cases the switch may not be labeled with the words IN or OUT. In cases where labeling is not present, sine dither is OUT when the switch toggle is pointing towards the right and IN when the switch toggle is pointing to the left.

**NOTE**

The top cover of the instrument must be removed and the A7 circuit card extracted for access to the sine dither switch. Power to the instrument should be removed and extreme caution should be exercised when extracting the A7 circuit card to prevent damage to the components on the circuit card.

### LEVEL (VOLTS) Touch Controls

Selects the input signal level for 10 mV through 20 V full scale input in 1, 2, 5 sequence for the following eleven ranges: 10 mV, 20 mV, 50 mV, 100 mV, 200 mV, 500 mV, 1V, 2V, 10V, and 20V. Signal level can be displayed in volts rms, O-P, or P-P as selected by the front-panel controls. The AUTO touch control, when depressed, automatically selects the proper voltage range that corresponds to the input signal. When the proper range is reached, the AUTO function stops and the LED goes out. Selected voltages will appear as alphanumerics on the crt. When the input signal exceeds the full scale limit, an overload condition will be indicated by a LED located on the VOLTS, LEVEL increase touch control upper left hand corner. An overload will cause the LED to stay lit constantly. The LED will indicate an overload condition when the Input A/D converter starts clipping the input samples.

### WTG Touch Control

When the WTG touch control is depressed and the LED turns on, Hanning weighting from internal ROMS is applied in the input data during transfer from Input Memory to Processor Memory, for those functions with which it can be used. When the WTG touch control is depressed again the LED goes out and Rectangular weighting is applied.

### SIGNAL Touch Controls

### TRANS ARM Touch Control

Local or remote command sets transient capture circuitry to trigger on the incoming data signal. 10% of the pre-trigger information is displayed.

### TEST Touch Control

Depressing the TEST touch control places an internally generated square wave calibration signal in the input. The fundamental of this signal has an amplitude of -10 dB from full scale and is located at cell 256 for all frequency ranges. This signal can be used for operational checkout of the instrument.

### AC Touch Control

Selects AC coupling for the input signal. This touch control must be selected for Input Levels of 50 mV and below.

### DC Touch Control

Selects DC coupling for the input signal.

### HOLD Touch Control

Depressing this control places the input memory in HOLD.

**NOTE**

When the HOLD mode is activated, the Input Group settings should not be changed. This will avoid incorrect frequency or level information on the crt display. Also when in the HOLD mode, selecting the TEST signal or the TRANSLATOR ON controls will have no effect on the crt display.

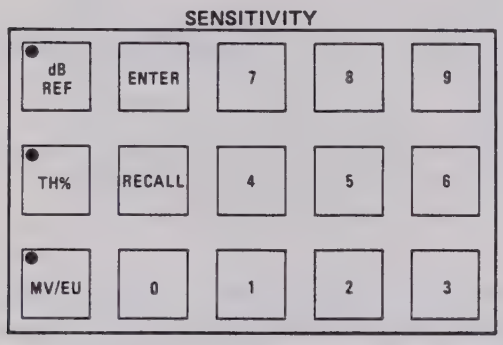
**UPDATE Touch Control**

Depressing this control allows the operator to update the information in the input memory.

**ACST WTG Touch Control**

Depressing this touch control applies acoustic weighting to the input signal. Acoustic "A" or "C" weighting is internally selectable on circuit card A5A3.

### 3.2.2 SENSITIVITY Group Keyboard




**dB REF Touch Control**

Selects dB reference sensitivity in units of dB (EU readout blanked). A lighted LED located in the upper left hand corner of the touch control indicates this mode is selected and any desired dB reference level can be selected for any point on the spectrum display. This is accomplished by moving the cursor to the desired reference point, selecting the desired dB reference level on the keyboard and depressing the ENTER touch control. The dB reading for any other selected point on the spectrum display will now be referenced to the set dB reference level (point). The value selected will appear in the upper right hand corner of the grid. After the dB value is selected and entered, the numerical REF value on the display will disappear. To recall the numerical value selected, depress the dB REF control and then the RECALL control. The numerical value of the dB reference selected will reappear momentarily and disappear again. (Refer to paragraph 3.5.4). If the dB REF touch control is depressed while the HMNC cursor is in Mode 1, the cursor will be the same as in the NORM mode. If the touch control is depressed while the HMNC cursor is in Mode 2, the cursor will be the same as in HMNC Mode 2 with the intensified dots frozen at the harmonics of the fundamental. (Refer to paragraph 3.2.6).

**TH% Touch Control**

Selects threshold percentage for the transient capture function. A lighted LED located in the upper left hand corner of the touch control indicates this mode is selected. Percentage values are selected by the keyboard and entered by the ENTER touch control.

The numerical display appears in the same place as the dB REF display and functions in the same manner. A 50% threshold level corresponds to 0 volt input signal. Threshold percentages between 50% and 100% indicate positive thresholds. Threshold percentages between 50% and 0% indicate negative thresholds.

**MV/EU Touch Control**

Selects transducer sensitivity in units of mV/EU. A lighted LED located in the upper left hand corner of the touch control indicates this mode is selected. Values are selected by the keyboard and entered by the ENTER touch control. The numerical display appears in the same location as the dB REF and TH% displays and functions in the same manner.

**ENTER Touch Control**

Enters the values selected for dB REF, TH%, mV/EU, and ADRS.

**RECALL Touch Control**

Recalls and momentarily displays the values entered for dB REF, TH%, mV/EU, PRGM SEL, and ADRS.

**Numbered Keyboard Touch Controls**

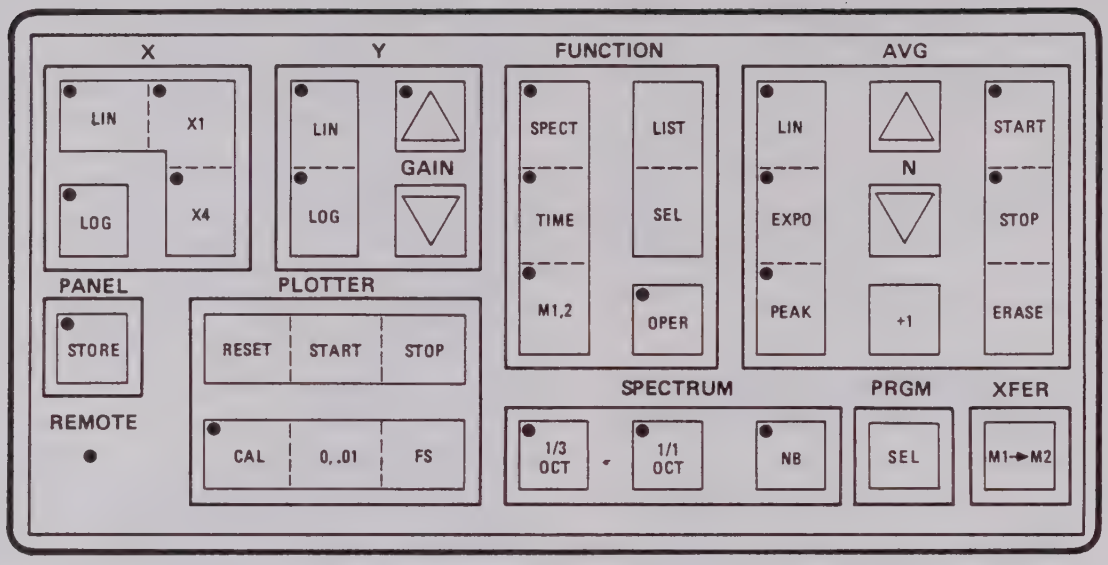
Provides means of entering units of sensitivity as follows:

For dB REF: 0 dB to 99.9 dB in 0.1 dB increments and 100 dB to 200 dB in 1.0 dB increments (138 dB is maximum at 10mVrms input level; 204 dB is maximum at 20 Vrms input level).

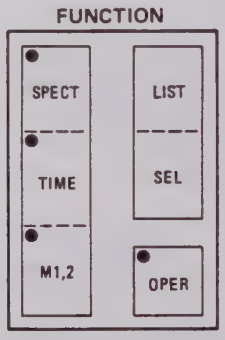
For TH%: 11% to 89% in 0.1% increments. The display range for TH% is as follows:

RMS: 0% to 100%
P-P: 37.5% to 62.5%
O-P: 25% to 75%

### 3.2.3 Analysis Group




**FUNCTION Touch Controls**




Provides selection of one of the following modes of operation:

**SPECT Mode**

Real time analysis, memory 1 averaging, memory 2 input, SYNC SPECTRUM, dual display of memory 1 and real time, dual display of memory 2 and real time, dual display of memory 1 and memory 2 can be displayed by stepping through the SEL touch control or by utilizing the LIST mode.

**TIME Mode**

Time, dual display of time and real time, SYNC TIME AVERAGING, dual display of time and memory 1, dual display of time and memory 2, can be displayed by stepping through the SEL touch control or by utilizing the LIST mode.

**M1,2 Mode**

Displays the following arithmetic functions: Memory 2 divided by memory 1, memory 1 divided by memory 2, memory 2 minus memory 1, memory 1 minus memory 2, and memory 1 plus memory 2 can be displayed by stepping through the SEL touch control or by utilizing the LIST mode.

**LIST Mode**

When the LIST touch control is depressed, the data display on the crt is blanked and a numbered list (MENU) of available display combinations for the selected function appears on the crt. An asterisk appears to the left of the selected function. Any function on the list can now be directly selected by depressing the desired keyboard number in the SENSITIVITY Group. The asterisk will move to the selected function. Depressing the OPER touch control will return the crt display to correspond with the selected function. Use this mode to display stored M1 and M2 information. Do not use the SEL mode to display stored M1 and M2 information.

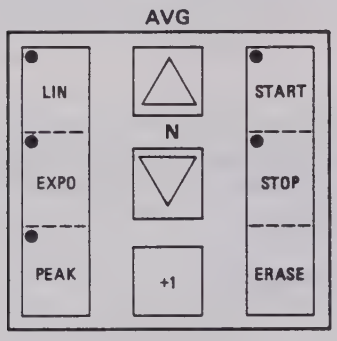
### SEL Mode

Performs the same function as the LIST mode with the following exceptions: The MENU is not displayed and random selection is not available. Function selection is accomplished by stepping through each function in sequence.

### OPER Mode

Initiates the selected function.

### AVG Touch Controls




### LIN Mode

Performs a linear average (ideal integrator) until the selected number of ensembles has been reached. The number of averages (from 2 to 1024) can be selected by depressing the N touch controls. The number selected will appear as an alphanumeric on the crt. When linear averaging is in process, the spectrum information is normalized at each binary step of the number of averages performed.

### EXPO Mode

Performs a linear average (ideal integrator) until the selected number of ensembles has been reached, then averaging continues exponentially with a selected time constant. When linear averaging is in process, the spectrum information is normalized at each binary step of the number of averages performed. Exponential averaging will continue indefinitely until terminated by depressing the STOP touch control.

### PEAK Mode

Retains the highest level in each of the 400 filter locations and for the overall signal until exceeded. Values can be stored by depressing the XFER, M1 → M2 touch control. This transfers the values from Memory 1 to Memory 2 for later use. Averaged values can be erased by depressing the ERASE touch control. Information for all 400 filter locations is updated approximately every 130 milliseconds.

### START Touch Control

Starts averaging process.

### STOP Touch Control

Freezes memory and N count.

### ERASE Touch Control

Clears Average Memory (M1).

### +1 Touch Control

On any given analysis range, each new ensemble is automatically processed every memory period. However, in the Add One Ensemble (+1) Mode, these ensembles can be processed manually when desired. The mode is initiated by pressing the AVG N, STOP, ERASE, and +1 controls in sequence. Linear, exponential or peak averaging can now be selected by pressing the appropriate LIN, EXPO or PEAK control. In the LIN/AVG mode, each time the +1 control is depressed, a new ensemble will be added, up to the number of averages selected on the AVG N touch controls.

The following information is the proper sequence selecting the +1 mode of operation:

a. Select the number of averages.

b. Press STOP.

c. Press ERASE.

d. Press +1 (Locks out automatic start).

e. Press LIN, EXPO or PEAK.

f. Press +1 for adding one ensemble to averaging process. (Up to selected number of averages in LIN.)

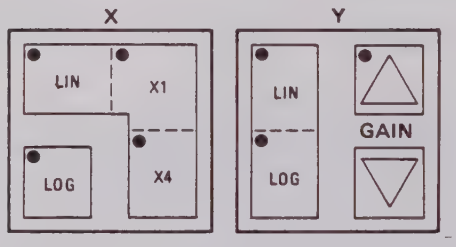
### AVG N Touch Controls

Selects the number of averages (from 2 to 1024). Average number selected is displayed by alphanumerics on the crt.

### XFER M1→M2 Touch Control

Transfers information from Memory 1 to Memory 2. When displaying the contents of M2, the following front-panel controls should be selected to reflect the same conditions at the time the M1 to M2 transfer occurred: Frequency range selection, TRANSLATOR controls, SPECTRUM controls, LEVEL controls and AVG controls.

### Display Mode Touch Controls




### Display Y Touch Controls

#### LIN Mode

Selects linear Y-axis with an output gain of X1, X2, X5 and X10 for crt display. Output gain can be selected by depressing the GAIN touch controls. Rear-panel outputs follow crt display whereas amplitude readings on crt alphanumerics remain normalized to the input signal.

#### LOG Mode

In the LOG mode the GAIN touch controls select +30 dB to -30 dB in 10 dB steps as follows:

| | Graticule Reading | Usable Range |
|---|---|---|
| 0 dB gain-display | 0 dB to -60 dB | 0 dB to -70 dB |
| 10 dB gain-display | -10 dB to -70 dB | -10 dB to -80 dB |
| 20 dB gain-display | -20 dB to -80 dB | -20 dB to -90 dB |
| 30 dB gain-display | -30 dB to -90 dB | -30 dB to -100 dB |
| 10 dB atten-display | +10 dB to -50 dB | +10 dB to -60 dB |
| 20 dB atten-display | +20 dB to -40 dB | +20 dB to -50 dB |
| 30 dB atten-display | +30 dB to -30 dB | +30 dB to -40 dB |

### Display X Touch Controls

#### LIN Mode

Provides for selection of either normal or expanded X axis sweep as follows:

#### X1

Provides normal X axis for crt and rear-panel outputs. All 400 filter locations and overall will be displayed in the frequency domain. Full memory contents will be displayed in the time domain.

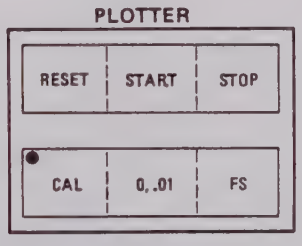
#### X4

Provides expanded X axis sweep for internal crt display. Approximately 100 filter locations will be displayed. By operating the CURSOR control left or right, any 25% (-12½ to +12½ %) of the X-axis can be selected for full screen viewing.

#### LOG Mode

Provides a logarithmic display of the X-axis information.

### PLOTTER Touch Controls




#### RESET Mode

Effective when the FUNCTION touch controls are in the SPEC, TIME or M1, 2 modes. Depressing the RESET touch control resets the cursor to the cell 1 position.

#### START Mode

Starts plotting in the SIMULPLOT mode when this touch control is depressed. Plotter pen will move at one of two rates selected from the rear panel (20 seconds and 40 seconds). Plotter pen will move at a rate of approximately 100ms per filter location and will require approximately 40 seconds to complete one plot when the rear panel selector is in the 40 second position. Plotter pen will move at a rate of approximately 50ms per filter location and will require approximately 20 seconds to complete one plot when the rear panel selector is in the 20 second position.

**STOP Mode**

Stops plotting mode, activates pen lift command, and allows updating to restart. When using X4 in the PLOTTER mode, the cursor dot will return to the center of the display upon completion of the plot.

**CAL / 0, .01 / FS**

Positions plotter pen on X-Y recorder for calibration and positions an intensified dot on an externally connected X-Y display for calibration.

Y-Axis: Log-full scale and -40 dB selectable.
Lin-full scale and linear zero selectable.
X-Axis: Lin-full scale and linear zero selectable.
Log-full scale and -2 decade selectable.

**NOTE**

If the display to be plotted is in LIN X format, insure that the DISPLAY X, LIN touch control is selected for plotting or calibrating the plotter. If the display to be plotted is in LOG X format insure that the DISPLAY X, LOG touch control is selected for plotting or calibrating the plotter.

**PANEL STORE Touch Control**

When this touch control is depressed the entire front-panel setup is stored in the Z-80 memory. The information entered by the PANEL STORE Touch Control can be recalled by depressing the center of the front-panel Spectral Dynamics LOGO. This function provides flexibility for storing any desired setup which can be recalled at any time at the operator's discretion. The setup is stored for approximately 10 days even if power is turned off. An internal battery supply keeps the stored front-panel information until power is restored to the equipment. If the battery supply is allowed to discharge while there is stored information, upon repowering the instrument, the PANEL STORE information will no longer be present. If the LOGO is depressed under these conditions it will return the equipment to the Initial POWER ON condition as described in Paragraph 3.5.1.

After the desired front-panel setup is selected and entered by depressing the PANEL STORE touch control, the LED located on the touch control will light. If the LOGO is depressed or if the equipment is turned off and then on again, the LED on the PANEL STORE Touch Control will go out.

This does not mean that the PANEL STORE function has lost its information. This is normal operation.

**NOTE**

When storing information in the dual display mode and displaying both TIME and SPECTRUM, it is advisable to place the cursor on the upper trace before storing the information. Values entered for mV/EU, dB REF and TH% will not be stored.

**REMOTE LED Indicator**

Indicates equipment is in the remote mode of operation when lighted.

**SPECTRUM Touch Controls (Standard Option)**

**1/3 OCT Touch Control**

Selects 1/3 octave contiguous-band spectrum analysis.

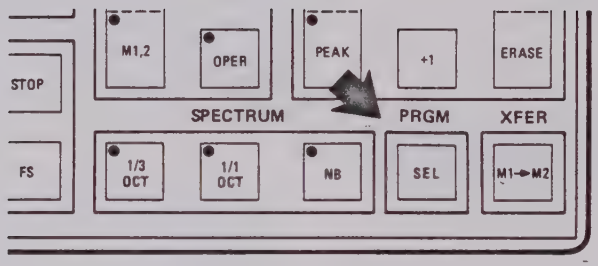
**1/1 OCT Touch Control**

Selects 1/1 octave contiguous-band spectrum analysis.

**NB Touch Control (Standard feature)**

Depressing the NB touch control restores the equipment to the standard (narrowband) mode of operation. Without the octave option the instrument must alway be in the NB mode.

**PRGM SEL Touch Control**




The PRGM SEL touch control is used to select special programs. The special programs consist of a menu display with menu subprogram selection. Menu display of the available programs can be displayed by depressing the PRGM SEL touch control and the FUNCTION group LIST touch control. When this is accomplished, the resulting display will be:

PROGRAMS

21. I, II, D, DD

22. DIGITAL PLOTTER

23. ID BLOCK

24. SELF TEST

Each special program has its own menu and can be selected as follows:

**PROGRAM 21** — INTEGRATION

Selection of PROGRAM 21 is accomplished in the following sequence: First depress the PRGM SEL touch control. Select the number 21 on the SENSITIVITY group keyboard. Depress the FUNCTION group LIST touch control. The following menu will be displayed:

INTEGRATION MENU

*1. NORMAL

2. I UNITS

3. II UNITS

4. I CM/SEC

5. II CM

6. I IN/SEC

7. II IN

8. D

9. DD

Selection of these functions can be accomplished as follows: On the SENSITIVITY group keyboard, select the number that corresponds to the desired function. The asterisk will move to the number of the function selected. Depress the FUNCTION group OPER touch control. The desired function will be displayed.

**PROGRAM 22** — DIGITAL PLOTTER

Selection of the DIGITAL PLOTTER MENU subprogram is dependent upon the presence of the '-3' Option in the instrument. (Refer to paragraph 1.5.3, Digital I/O

System (-3 Option) located in Section I.) If the '-3' Option is not installed, the crt will display "OPTION AVAILABLE" when this subprogram is selected. If the '-3' Option is installed, selection of PROGRAM 22 is accomplished in the following sequence: First depress the PRGM SEL touch control. Select the number 22 on the SENSITIVITY group keyboard. Depress the FUNCTION group LIST touch control. The following menu will be displayed:

PLOTTER MENU

*1. ANALOG PLOTTER

2. DIGITAL PLOT

3. GRIDS

4. ANNOTATION

5. DATA TRACE

Selection of these functions can be accomplished as follows: On the SENSITIVITY group keyboard, select the number that corresponds to the desired function. The asterisk will move to the number of the function selected. Depress the FUNCTION group OPER touch control. The instrument is now ready to initiate the desired plot as follows:

**ANALOG PLOTTER** (PLOTTER MENU Selection 1.)

When this mode is selected the PLOTTER group touch controls have control over the plotting function as described in paragraph 3.2.3 Analysis Group, subparagraph PLOTTER Touch Controls.

**DIGITAL PLOT** (PLOTTER MENU Selection 2.)

Selecting this mode will result in a complete digital plot of the grid, alphanumerics and data input. This is accomplished by selecting PLOTTER MENU Selection 2 and then depressing the PLOTTER group START touch control. When the plot is completed, the operator may, if it is desired, plot multiple overlays of the input data without repeating the grid and alphanumerics by depressing the PLOTTER group START touch control. This can be repeated as many times as desired as long as the DIGITAL PLOT is completed and no other selection is made.

**GRIDS** (PLOTTER MENU Selection 3.)

Selecting this mode will result in the display grid only being plotted. To plot the grid, depress the PLOTTER group START touch control. After the grid is plotted, the asterisk on the PLOTTER MENU will automatically move to selection 4, ANNOTATION.

**ANNOTATION** (PLOTTER MENU Selection 4.)

When this mode is selected or after the grid is plotted, depressing the PLOTTER group START touch control will cause the instrument to plot all of the displayed alphanumerics. After the alphanumerics are plotted, the asterisk on the PLOTTER MENU will automatically move to selection 5, DATA TRACE.

**DATA TRACE** (PLOTTER MENU Selection 5.)

When this mode is selected or after the annotation is plotted, depressing the PLOTTER group START touch control will cause the instrument to plot the displayed data input information. When the plot is completed, the asterisk will remain at selection 5. Depressing the PLOTTER group START touch control again will plot another trace of data input information. This allows the operator to plot one grid, one set of alphanumerics, multiple overlay plots or any combination of PLOTTER MENU selections 3, 4 and 5 by stepping around the undesired selections.

**Use of the PLOTTER Group RESET Touch Control**

The PLOTTER group RESET touch control recalls the last function selected by the operator from the PLOTTER MENU. For example: If PLOTTER MENU Selection 3 is made by the operator and the operator decides to plot selections 3, 4 and 5 separately by allowing the instrument to step to each selection automatically as previously described; upon reaching selection 5, if RESET is depressed, the instrument will return to selection 3, the last selection made by the operator.

**PROGRAM 23** — ID BLOCK

Selection of PROGRAM 23 is accomplished in the following sequence: First depress the PRGM SEL touch control. Select the number 23 on the SENSITIVITY group keyboard. Depress the FUNCTION group LIST touch control. The following menu will be displayed:

ID BLOCK MENU

*1. OFF

2. ON

Selection of this function can be accomplished as follows:

On the SENSITIVITY group keyboard, select the number 2. The asterisk on the menu will move to number 2. Depress the FUNCTION group OPER touch control. The letters "ID" will appear on the upper left of the crt. The SENSITIVITY group keyboard will now be enabled such that any number entered will move into the LSB of the ID number. A complete ID number will be "ID XXXX". As long as the ID BLOCK is ON and the SENSITIVITY group keyboard is not being used for sensitivity or list, the keyboard will always be enabled for the ID BLOCK.

**PROGRAM 24 —** SELF TEST

Selection of PROGRAM 24 is accomplished in the following sequence: First depress the PRGM SEL touch control. Select the number 24 on the SENSITIVITY group keyboard. Depress the FUNCTION group LIST touch control. The following menu will be displayed:

SELF TEST MENU

*1. OFF

2. ON

Selection of this function can be accomplished as follows: On the SENSITIVITY group keyboard, select the number 2. The asterisk on the menu will move to number 2. Depress the FUNCTION group OPER touch control. The self test will start and the SELF TEST MENU will automatically reset to 1 (OFF).

Listed below are descriptions of the self test functions. There are eight self tests. All tests use the front-panel test signal as a source of predictable outcome.

Test No. 1 — Real time spectrum. The front-panel test signal is checked every 40 cells using the DELTA P mode. The acceptable limits are listed in the following table:

| **Cell No.** | 40 | 80 | 120 | 160 | 200 |
|---|---|---|---|---|---|
| **Min.** | — | — | — | — | — |
| **Max.** | −50 dB | −49 dB | −48 dB | −47 dB | −47 dB |

| **Cell No.** | 240 | 280 | 320 | 360 | 400 |
|---|---|---|---|---|---|
| **Min.** | — | −10.5 dB | — | — | — |
| **Max.** | −47 dB | −9.5 dB | −9.5 dB | −9.5 dB | −9.5 dB |

Test No. 2 — M1 average. 16 averages of the front panel test signal are taken. M1 is then checked as in test no. 1.

Test No. 3 — M1 transfer to M2. The resulting M1 data of test no. 2 is transferred to M2. M2 is then checked as in test no. 1.

Test No. 4 — Plus 1 averaging. Number of averages is set to 2. +1 is pushed twice and M1 is then checked as in test no. 1.

Test No. 5 — M1 erase. DELTA P mode is used and the cursor value is checked at cell 400 for exactly −70.0 dB.

Test No. 6 — Volts, EU, PSD. The cursor is checked at cell 256 for various Y axis units as listed in the table below.
10 mV/EU sensitivity is used.

| **UNITS** | **V** | **EU** | **PSD** |
|---|---|---|---|
| **MIN.** | .299 | 29.9 | 23.84 |
| **MAX.** | .335 | 33.5 | 29.93 |

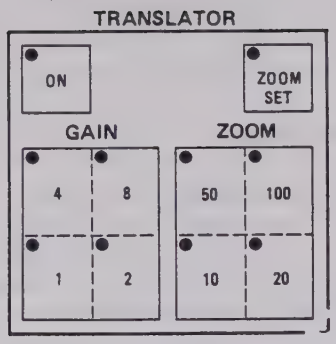
Test No. 7 — Translator. The translator is turned on and the ZOOM SET is set at cell 256. The cursor is checked at the center of the screen for −10.5 dB to −9.5 dB. This test is skipped if the translator option is not installed.

Test No. 8 — 1/3, 1/1 Octave. 1/3 octave is turned on and the cursor is checked at band number 28 for −10.5 dB to −9.5 dB. 1/1 octave is then turned on and the cursor is checked at band number 10 for −10.5 dB to −9.5 dB. This test is skipped if the 1/3, 1/1 octave option is not installed.

Upon completion of the self test, a list of results will appear on the crt and these results will get a pass or fail indicated by a P or F after the test number. If all the tests pass, the instrument will automatically return to the normal mode of operation. If any of the tests fail, the list on the crt will remain until any one of the front-panel controls are depressed.

**NOTE**

The FUNCTION group SEL touch control is also operable in the PRGM SEL mode. If it is desired to use the FUNCTION group SEL touch control while in the PRGM SEL mode, the LIST mode must be selected first.




### 3.2.4 TRANSLATOR Group (Standard Option)

The TRANSLATOR Group controls the operation of the optional Translator which is used to expand any section of the spectrum for improved resolution and to separate closely spaced components for easy identification.

**ON Touch Control**

Turns on the Translator and places the center frequency at the present cursor position.

**GAIN Touch Control**

Provides amplitude gain for the selected center frequency in 6 dB steps as follows: Gain 1, no gain (unity) — Gain 2, 6 dB — Gain 4, 12 dB — Gain 8, 18 dB. Gain is inserted after the translation process prior to the FFT analysis.

**ZOOM SET Touch Control**

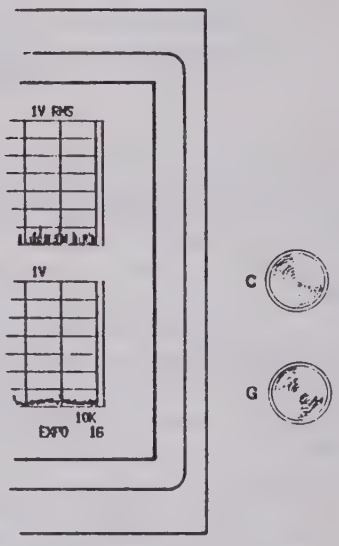
Locks the center frequency at the cursor position. The cursor can now be moved freely without changing the center frequency. Depressing the ZOOM SET control again will redefine the center frequency to the current cursor position. If the ZOOM SET control is not used the center frequency will change each time the cursor is moved.

**ZOOM Touch Control**

Provides expansion around the center frequency (Refer to ZOOM SET Touch Control explanation) as follows:

| Zoom Select | Expansion |
|---|---|
| 10 | 20 cells→200 cells |
| 20 | 10 cells→200 cells |
| 50 | 4 cells→200 cells |
| 100 | 2 cells→200 cells |

### 3.2.5 CRT Group




TV raster scan display. Complete grid lines are automatically generated for non-parallax viewing in LIN or LOG, X or Y format. Available displays are explained in the FUNCTION Control section located in the ANALYSIS Group. When the SPECT mode is selected, the overall rms value of the input data is displayed at the extreme right of the grid in cell locations 401 through 409.

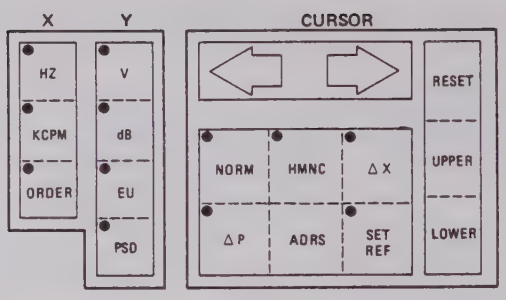
**Contrast Control**

Controls the overall display intensity and contrast.

**Grid Control**

Controls the grid intensity only.

### 3.2.6 CURSOR Group




**X Y Touch Controls**

The X Y touch controls select the units for the alphanumeric values to be displayed on the crt as follows:

**HZ Touch Control**

Alphanumeric readout displays frequency in Hz of the actual cursor location.

**KCPM Touch Control**

Alphanumeric readout displays frequency in KCPM of the actual cursor location.

**ORDER Touch Control**

When the HMNC cursor mode has been selected and the intensified dots are frozen, (SET REF) the alphanumeric readout displays the location of the cursor in terms of its harmonic relationship to the fundamental component.

**V Touch Control**

Alphanumeric readout displays amplitude at the cursor location in volts rms, Volts P-P or Volts O-P depending on the mode selected by the Input Group, LEVEL touch controls.

**dB Touch Control**

Alphanumeric readout displays amplitude in dB of the cursor location. The dB readings will have prescribed reference levels as follows:

a. With the CURSOR Group touch controls in the NORM or HMNC positions and SENSITIVITY Group touch control in the mV/EU or TH% position, the full scale level selected by the Input Group VOLTS selector, will represent 0 dB.

b. With the SENSITIVITY Group touch control in the dB REF position, readings will be referenced to the set dB REF and will track with changes in the position of the Input Group VOLTS selector.

**EU Touch Control**

Alphanumeric readout displays amplitude in engineering units at the cursor location. The Display Group Y touch controls can be in either LIN or LOG position. The readings correspond to transducer sensitivities entered via the SENSITIVITY Group keyboard. The crt display is attenuated to provide a convenient full scale display of 0.1 through 20,000 in 1,2,5 sequence. In certain conditions full scale of 2.5 and 4 sequence also exists. The selected full scale can be read by placing the PLOTTER Group touch controls in the CAL-F.S. position.

**PSD Touch Control**

Selects Power Spectral Density mode of operation represented by $(\frac{EU^2}{Hz})$ Data amplitude display and readout is automatically normalized to 1 Hz effective noise bandwidth.

**CURSOR Left/Right Control**

Touch Controls with arrows pointing to the left and right control the horizontal movement of the cursor on the crt display. Depressing either touch control once changes the position of the cursor by one step (left or right). Holding the control in either position provides continuous movement of the cursor across the crt display (left or right) at approximately 0.5 seconds after it receives the command.

**NORM Touch Control**

In this mode, the cursor consists of an intensified dot which can be moved to any of the 400 cell locations and the overall signal (cells 401 through 409) on the crt display. When the intensified dot is moved, it is accompanied by a vertical line. The alphanumeric readout will display the data at the cursor location as selected by the CURSOR Group X-Y touch controls.

**HMNC Touch Control**

In this mode, an intensified dot is automatically placed on the crt display at all multiples of the cursor location. The harmonic cursor has two distinct modes of operation depending upon the set command from the SET REF touch control as follows:

**Mode 1 — Align Higher Order Harmonics**

This mode is selected when the CURSOR Group selection is switched from NORM to HMNC. The cursor has a finer resolution of 256 parts for the fundamental position to permit more precise alignment of the intensified dots of the higher order harmonics of the fundamental. This alignment can be achieved by moving the cursor control as required.

**Mode 2 — Freeze ORDERS Aligned in Mode 1**

This mode is selected by depressing the SET REF touch control after completing the alignment of Mode 1. When the SET REF touch control is depressed, the positions of the intensified dots are frozen and a line cursor appears at the fundamental. The line cursor (intensified dot plus vertical line) can now be moved to any of the 400 cell locations of the crt display. The alphanumeric readout will display data at the line cursor location as selected by the X Y units selectors. The SET REF touch control provides alternate selection between Mode 1 and Mode 2.

**ΔX Touch Control**

The ΔX mode of operation can be selected in either the NORM or the HMNC mode as follows:

**NORM Mode**

When ΔX is selected, a line and dot appear on the display and the ΔX LED will be on. If no other mode is selected, the equipment will still be in the NORM mode with a permanent line cursor. When the SET REF touch control is depressed in the ΔX mode, the line cursor will become frozen at its present position and another line cursor accompanied by the intensified dot will appear when the cursor is moved to the right or left. The Hz and KCPM readout will be referenced to the frozen line cursor and will appear as positive values on either side of the frozen line. In this mode the X-axis cursor value will be designated DX representing the difference between the the two cursor lines.

**HMNC Mode**

The ΔX mode can be selected while the instrument is in the HMNC mode as follows: First select HMNC Mode 2. Move the cursor to any point on the display. Depress ΔX. The SET REF LED will go out. Depress SET REF. The SET REF LED will come back on. ΔX will now function as it does in the NORM mode. To go back to HMNC Mode 2, depress SET REF, then depress HMNC. The instrument will return to the original HMNC, SET REF setting. Note that while in the ΔX mode that HZ, KCPM and ORDERS will read zero at the frozen cursor position.

**ΔP Touch Control**

Provides a summation of the rms value of the power level of all the displayed information to the left of the cursor, regardless of its position on the display. Changing the position of the cursor will vary the power level. The ΔP mode also operates in conjunction with the ΔX mode. The Y-axis cursor value in this mode will be designated DP representing the RMS value of spectrum information displayed on the crt.

**ADRS Touch Control**

The ADRS touch control operates in conjunction with the SENSITIVITY Group touch controls. (Refer to paragraphs 3.2.2, SENSITIVITY Group and 3.5.4 SENSITIVITY Selection.) When the ADRS touch control is depressed, the crt display will appear as shown in paragraph 3.5.4, figure 3-7 and will read ADRS 0000. The operator may then place the cursor at any cell location on the display as follows: depress the ADRS touch control. Utilizing the SENSITIVITY Group keyboard, select any cell location between 1 through 409. (Overall is located in cells 401 through 409.) Depress the ENTER touch control. The cursor will appear at the selected cell location.

**SET REF Touch Control**

This touch control has a dual function depending upon the position of the CURSOR Group touch controls as follows:

**HMNC Mode**

If the CURSOR Group HMNC touch control is depressed, depressing the SET REF touch control freezes the intensified dots at the harmonics of the fundamental; depressing the SET REF touch control again clears the freeze condition.

**ΔX Mode**

If the CURSOR Group ΔX touch control is depressed, a permanent line cursor will appear at the present cursor location. When the SET REF touch control is depressed in the ΔX mode, the line cursor will become frozen at its present position and another line cursor accompanied by the intensified dot will appear when the cursor is

moved to the right or left. Values in HZ, KCPM or ORDERS will be referenced to the frozen line cursor.

**RESET Touch Control**

Resets the cursor to the beginning of the trace.

**UPPER Touch Control**

Places the cursor on the upper trace when the analyzer is in a dual display mode.

**LOWER Touch Control**

Places the cursor on the lower trace when the analyzer is in a dual display mode.

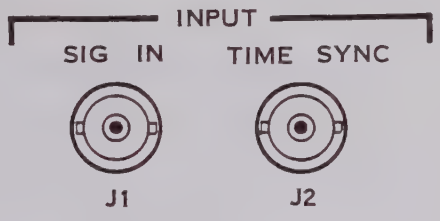
### 3.2.7 PWR Push Button/Indicator

Push to turn instrument power ON or OFF; lighted when on.

## 3.3 REAR PANEL FUNCTIONAL DESCRIPTION

Figure 3-2 is a rear view of the SD345. The following paragraphs briefly describe the function of each of the rear-panel connectors, switches, and power input components.

### 3.3.1 INPUT Group




**SIG IN BNC Connector (J1)**

Accepts the input analog data signal for analysis. Connected in parallel with the front-panel INPUT BNC connector.

**TIME SYNC BNC Connector (J2)**

Accepts external TTL level sync pulse for initiating the data load for Time Sync Averaging and Sync Spectrum functions.

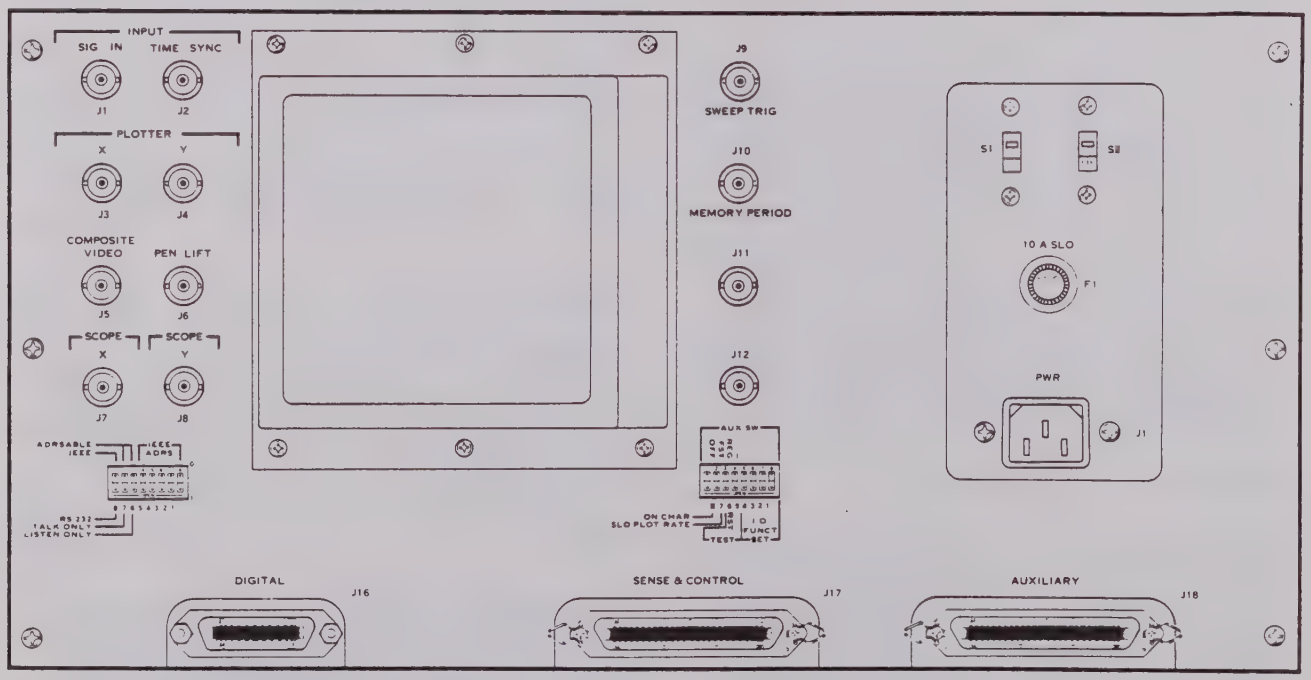
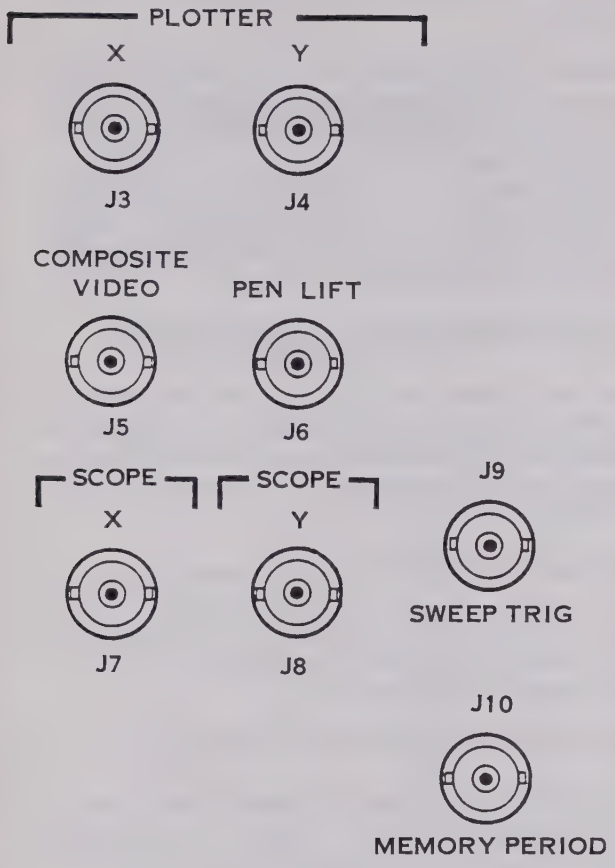



**Figure 3-2. Model SD345 Rear Panel.**

### 3.3.2 Output Group




**PLOTTER X BNC Connector (J3)**

Provides the X-axis output signal for an external X-Y recorder. When the FUNCTION group SPECT or M1,2 mode is selected, X-axis output corresponding to cursor location is available at this output.

**PLOTTER Y BNC Connector (J4)**

Provides the Y-axis output signal for an external X-Y recorder. When the FUNCTION group SPECT or M1,2 mode is selected, Y-axis output corresponding to cursor location is available at this output.

**COMPOSITE VIDEO BNC Connector (J5)**

Provides a composite video signal for use with an external raster scan display or video hard copy recorder that requires a composite signal.

**PEN LIFT BNC Connector (J6)**

Provides contact closure to lower the pen on the X-Y recorder when the front-panel PLOTTER group START touch control is depressed.

**SCOPE Y BNC Connector (J7)**

Provides the Y-axis output signal for an external X-Y display unit.

**SCOPE X BNC Connector (J8)**

Provides the X-axis output signal for an external X-Y display unit.

**SWEEP TRIG BNC Connector (J9)**

Provides retrace blanking for an external X-Y display unit.

**MEMORY PERIOD BNC Connector (J10)**

Provides a TTL compatible pulse once every memory period for use with the SD25-80-1 and the TEK 611 oscilloscope or on equipment that requires sweep information be written only once every memory period.

### 3.3.3 Miscellaneous Group

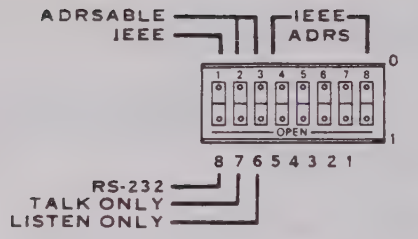
**DIP Switches**

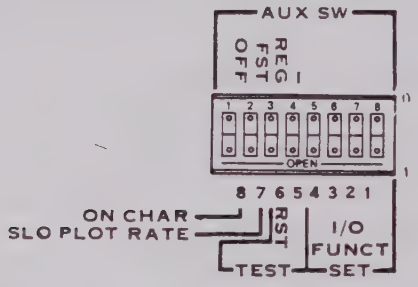
**NOTE**

There are two DIP switches located on the rear panel. Each of these switches actually consists of eight separate switches. Any labeling on the switches themselves should be disregarded. Any reference to the labeling of these switches refers to the labeling on the rear panel.

**IEEE ADRS Switches (Switches 1 through 5)**

These switches are used to select the IEEE address. The 0 and 1 located to the right of the switches denotes whether the switch is in the logical high or low position. Switch 1 represents the LSB of the address and the address is set up in positive true format, that is, the 1 position represents a binary '1' and the 0 position represents a binary '0'.




**ADRSABLE/TALK ONLY/LISTEN ONLY Switches (Switches 6 and 7)**

These switches select between the ADDRESSABLE, TALK ONLY, or LISTEN ONLY modes as follows:

| SW7 | SW6 | |
|---|---|---|
| 0 | 0 | ADDRESSABLE |
| 1 | 0 | TALK ONLY |
| 0 | 1 | LISTEN ONLY |
| 1 | 1 | INVALID |

**IEEE/RS232 Switch (Switch 8)**

This switch selects between IEEE and RS 232 operation.

**NOTE**

Switches 1 through 8 on the IEEE DIP Switch and switches 1 through 4 on the AUX SW DIP Switch are used only with units that have the '-3' Option installed. A brief explanation for the '-3' Option can be found in paragraph 1.5.3, Section I of this manual. Expanded information on the operation of these switches can be found in the '-3' Option Manual (Document No. 21188700) which is included with the '-3' Option.

**AUX SW/ I/O FUNC SET Switches (Switches 1 through 4)**

These switches are used to select the address to be used when the equipment is in the TALK ONLY or LISTEN ONLY modes of operation. The 0 and 1 located to the right of the switches denotes whether the switch is in the logical high or low position. Switch 1 represents the LSB of the address and the address is set up in positive true format, that is, the 1 position represents a binary '1' and the 0 position represents a binary '0'.

**AUX SW/TEST Switches (Switches 5 and 6)**

These switches are test functions. Information concerning the operation of these switches is contained in the Service Manual. When the equipment is not being tested or serviced, switches 5 and 6 should both be in the logical high position.

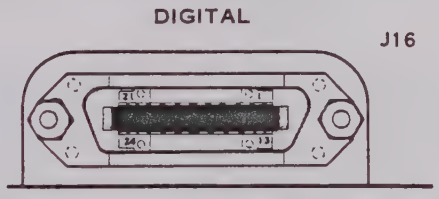
**AUX SW/FST/SLO PLOT RATE Switch (Switch 7)**

This switch selects plotter speed. If the 1/3 Octave Option is used while plotting, use only the SLO PLOT RATE position of this switch.

**AUX SW/OFF/ON CHAR Switch (Switch 8)**

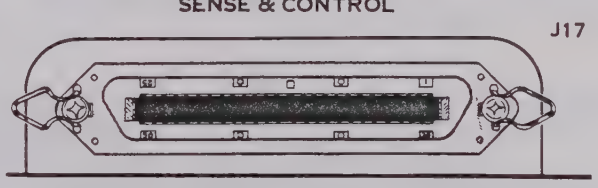
This switch turns the raster scan display alphanumerics (all the numbers and letters) on or off. The grid display and any input information displayed will remain.

**DIGITAL Multipin Connector (J16)**



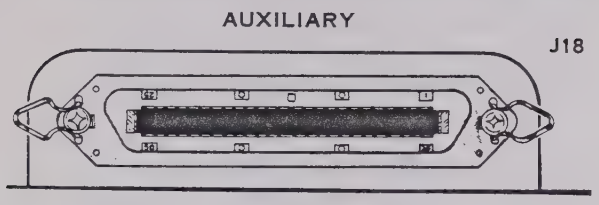

This is a 24-pin Amphenol connector which satisfies the requirements of Section 4 of IEEE Std. 488-1978. It provides interconnect to the GPIB. Refer to Table 3-1 for pin assignments.

**SENSE & CONTROL Multipin Connector (J17)**




Provides inputs and outputs for pulse and logic level control for the REMOTE mode of operation. Refer to Table 3-2 for pin assignments.

**AUXILIARY Multipin Connector (J18)**




Provides outputs for TEK 4632 Hard Copy Recorder and for an external raster scan display and Signature Ratio Adapter. Refer to Table 3-3 for pin assignments.

**Table 3-1. DIGITAL Connector (J16) Pin Assignments.**

| Pin | Assignment |
|---|---|
| 1 | DI01 |
| 2 | DI02 |
| 3 | DI03 |
| 4 | DI04 |
| 5 | E01 |
| 6 | DAV |
| 7 | NRFD |
| 8 | NDAC |
| 9 | IFC |
| 10 | SRQ |
| 11 | ATN |
| 12 | GND A |
| 13 | DI05 |
| 14 | DI06 |
| 15 | DI07 |
| 16 | DI08 |
| 17 | REN |
| 18 | GND B |
| 19 | GND B |
| 20 | GND B |
| 21 | GND B |
| 22 | GND B |
| 23 | GND B |
| 24 | GND B |

**Table 3-2. SENSE & CONTROL Connector (J17) Pin Assignments.**

| Pin | Assignment |
|---|---|
| 1 | GND B |
| 2 | REMOTE PLOTTER RESET |
| 3 | REMOTE MEM HOLD |
| 4 | REMOTE AVG ERASE |
| 5 | REMOTE + 1 AVG |

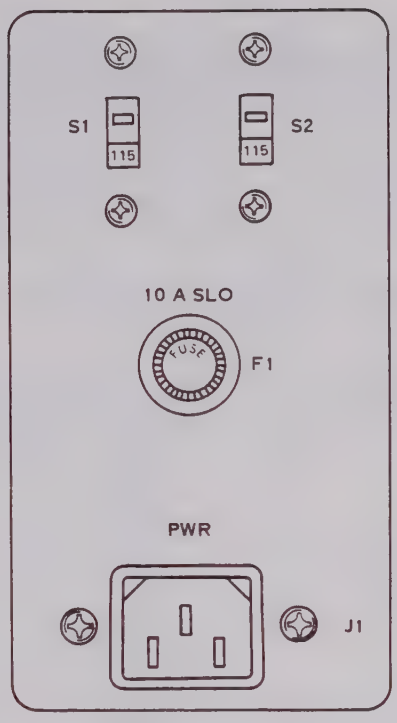
**Table 3-2. SENSE & CONTROL Connector (J17) Pin Assignments. (Continued)**

| Pin | Assignment |
|---|---|
| 6 | REMOTE PLOTTER START |
| 7 | DI05 |
| 8 | DI01 |
| 9 | DI03 |
| 10 | DI02 |
| 11 | DI04 |
| 12 | DI06 |
| 13 | RETRACE BLANK |
| 14 | REMOTE MEM TRANS |
| 15 | END OF PLOTTER SWEEP OUT |
| 16 | REMOTE MEMORY UPDATE |
| 17 | SWEEP RATE FEEDBACK DISABLE |
| 18 | SPARE |
| 19 | SCOPE X |
| 20 | REMOTE AVG START |
| 21 | REMOTE BUFFERED |
| 22 | SEL EXT SAMPLE |
| 23 | DC NORM/ACOUSTIC WTG |
| 24 | SYNC |
| 25 | CHASSIS GND |
| 26 | GND B |
| 27 | DATA TERMINAL READY |
| 28 | REQUEST TO SEND |
| 29 | TRANSMITTED DATA |
| 30 | RING INDICATOR |
| 31 | DI07 |
| 32 | SD346 OPER |
| 33 | DI08 |
| 34 | RECEIVED LINE SIGNAL DETECTOR |
| 35 | DATA SET READY |
| 36 | CLEAR TO SEND |
| 37 | RECEIVED DATA |
| 38 | TRANS COMPL BUFF |
| 39 | LINE CURSOR |
| 40 | PLOTTER SWEEP OUT |
| 41 | REMOTE TRANS ARM/RELEASE |
| 42 | SINE DITHER DISABLE |
| 43 | OUT 1 |
| 44 | SCOPE Y |
| 45 | DISPLAY REQUEST |
| 46 | MEM PERIOD |
| 47 | EXT TRANS CAPT TRIG |
| 48 | EXT SAMP FREQ |
| 49 | DISABLE F/P TRANS TRIGGER |
| 50 | SPARE |

**Table 3-3. AUXILIARY Connector (J18) Pin Assignments.**

| Pin | Assignment |
|---|---|
| 1 | GND A |
| 2 | VIDEO |
| 3 | GND A |
| 4 | SPARE |
| 5 | GND A |
| 6 | HORIZ DRIVE |
| 7 | GND A |
| 8 | SPARE |
| 9 | SPARE |
| 10 | GND A |
| 11 | TV VERTICAL RETRACE |
| 12 | GND A |
| 13 | SPARE |
| 14 | SPARE |
| 15 | SPARE |
| 16 | HORIZ BLANK |
| 17 | SPARE |
| 18 | SPARE |
| 19 | SPARE |
| 20 | SPARE |
| 21 | SPARE |
| 22 | SPARE |
| 23 | SPARE |
| 24 | SPARE |
| 25 | SPARE |
| 26 | SPARE |
| 27 | SPARE |
| 28 | SPARE |
| 29 | SPARE |
| 30 | SPARE |
| 31 | SPARE |
| 32 | SPARE |
| 33 | SPARE |
| 34 | SPARE |
| 35 | SPARE |
| 36 | SPARE |
| 37 | SPARE |
| 38 | SPARE |
| 39 | SPARE |
| 40 | SPARE |
| 41 | SPARE |
| 42 | SPARE |
| 43 | SPARE |
| 44 | SPARE |
| 45 | SPARE |
| 46 | SPARE |
| 47 | SPARE |
| 48 | SPARE |
| 49 | SPARE |
| 50 | SPARE |

### 3.3.4 Power Group




**115/230 Switches (S1 and S2)**

Provides switching of primary power input circuits for either 115 Vac or 230 Vac operation. Proper input voltage to be applied shows in windows. Both switches must always be in the same position.

**Fuseholder (F1)**

Accepts 3AG type SLO-BLO fuse, 10A.

**PWR Connector (J1)**

Accepts 3-wire plug and cable for applying 115/230 Vac, 47-65 Hz primary input power. Center terminal is chassis ground. Belden No. 17250 power cord is supplied for 115 Vac operation.

## 3.4 PRELIMINARY POWERING

The SD345 is designed to operate on either 115 Vac or 230 Vac, therefore, before applying power to the instrument, the following steps should be accomplished.

a. Check the rear panel transformer slide switches to ensure that they are in the proper position for the line voltage to be used. Both switches must be in the same position.

b. Ensure that the proper size fuse is installed in the fuse holder on the rear panel. This should be a 10A SLO-BLO fuse for both 115 Vac and 230 Vac.

c. Ensure that the cooling fan air inlet is free from obstructions.

d. Low line voltage operation is explained in paragraph 2.4.1 subparagraph c.

After the proper voltage and fuse have been selected, insert the power cord and connect it to the primary power source. Depress the front-panel POWER push button/indicator. The indicator should light indicating that the instrument is ON.

## 3.5 FRONT PANEL CONTROL FAMILIARIZATION

The following paragraphs contain information to familiarize the operator with the front-panel controls and crt alphanumerics prior to operational checkout.

### 3.5.1 Initial POWER ON Condition

Figure 3-3 is an illustration of the Initial POWER ON display. The spectrum information displayed in Figure 3-3 is shown as an example and will not appear during Initial POWER ON unless an input signal is applied to the instrument. Figure 3-4 is an illustration of the Initial POWER ON Condition. This condition can be modified as explained in the paragraph for the PANEL STORE Touch Control located on page 3-7.

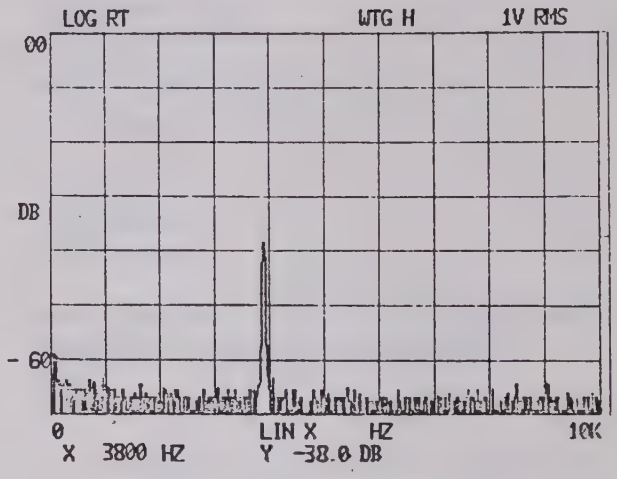



**Figure 3-3. Initial POWER ON Display.**

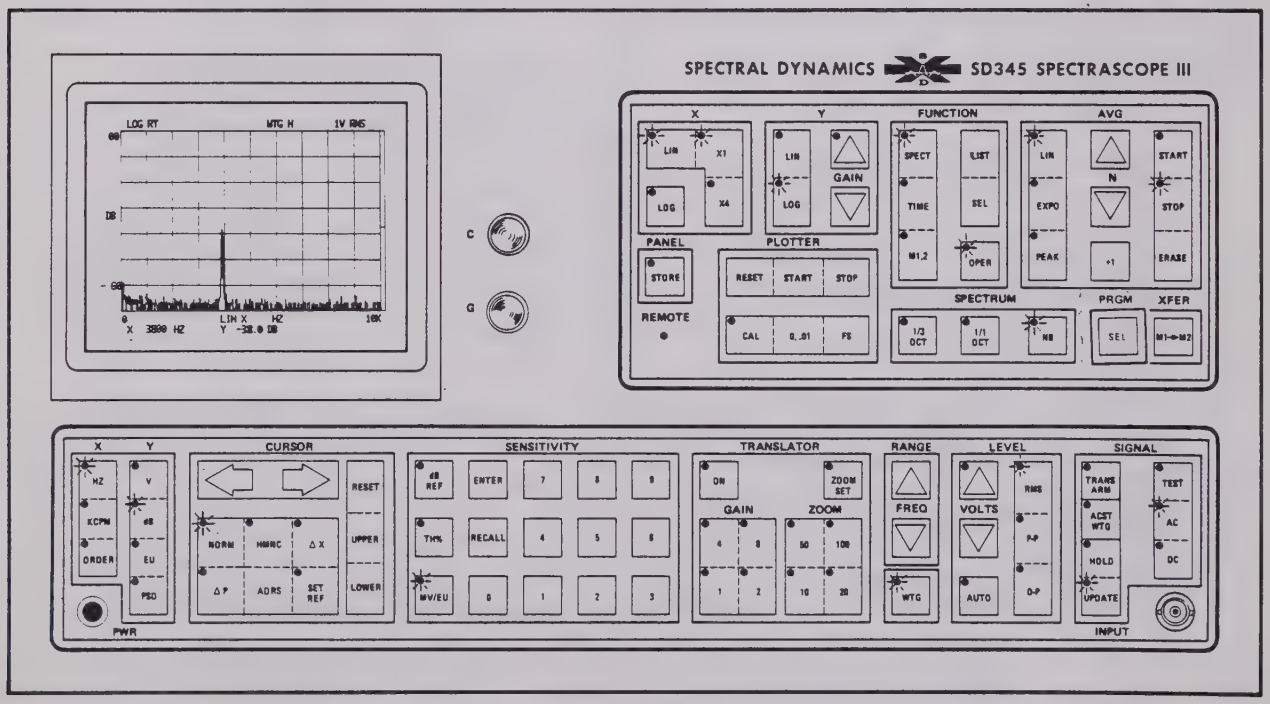



**Figure 3-4. Front panel description of the Initial POWER ON Condition. LEDS with this indication ✳ should be lighted during Initial POWER ON.**

### 3.5.2 Display and Control Familiarization

Figure 3-5 and Table 3-4 are provided to familiarize the operator with the function and display capabilities of the equipment.

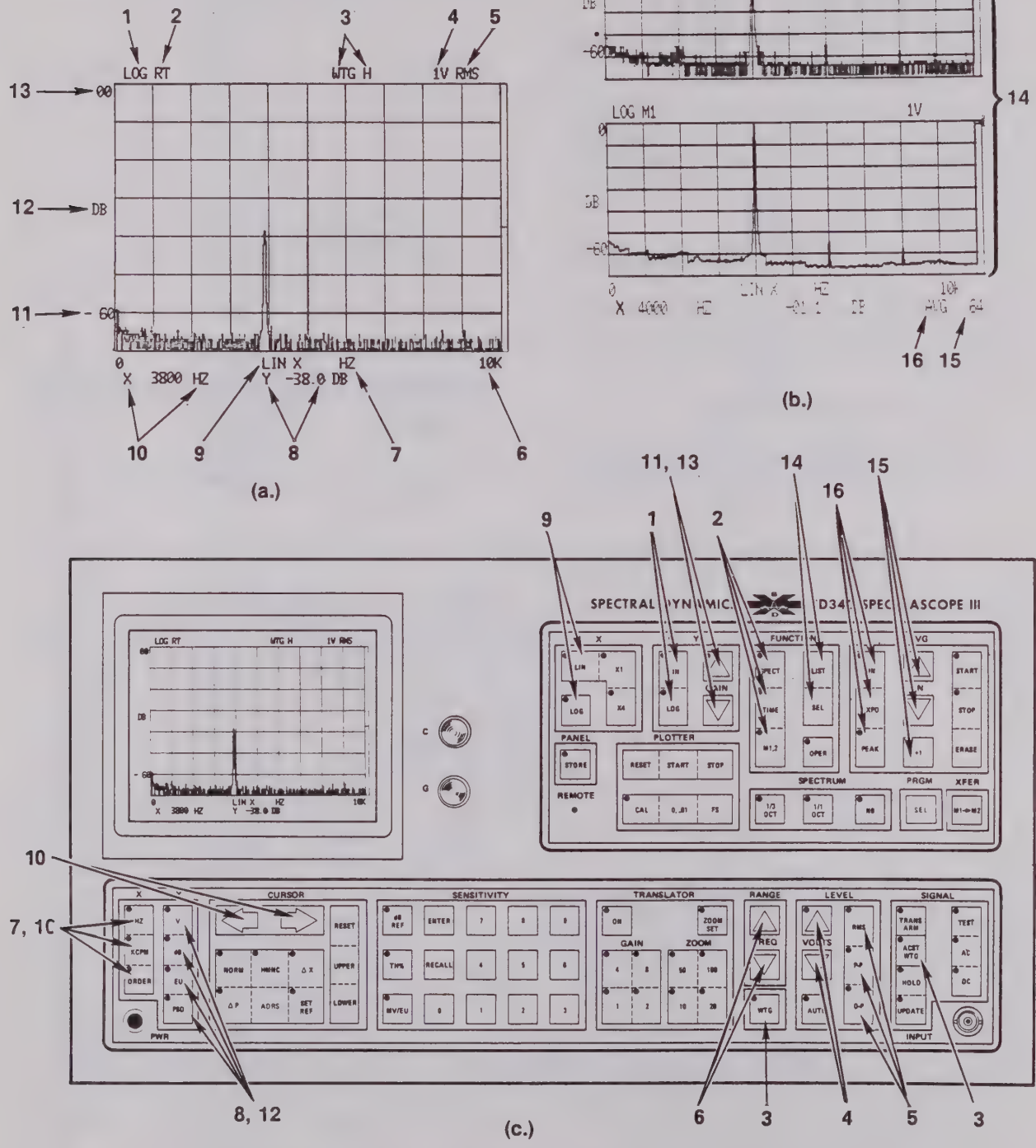



**Figure 3-5. CRT Alphanumerics and Related Front-Panel Controls.**

**Table 3-4. Description of Figure 3-5a, b & c.**

| Display Information | Display Variation |
|---|---|
| **1.** Y-axis format of the spectrum information. | LIN or LOG |
| **2.** Representation of the display. | RT-Real Time<br>M1-Active averager memory<br>M2-Storage memory<br>TIME-Input memory<br>TIME AVG-Synchronous Time Averaging<br>SYNC SPECT-Synchronous Spectrum |
| **3.** Weighting selected. | H-Hanning<br>R-Rectangular<br>ACT-Acoustic |
| **4.** Input level selected. | Eleven full scale ranges from 10mV to 20V in 1,2,5 sequence. |
| **5.** Voltage level measurement parameter. | RMS, O-P, P-P |
| **6.** Analysis frequency range or memory period. | Sixteen full scale ranges from 1 Hz to 100 kHz in 1,2,5 sequence. When the display is in the TIME mode, the full scale memory period displayed will be the reciprocal of the resolution of the full scale analysis range. For example, if the TIME mode is selected when the instrument is in the 10 kHz analysis range, the full scale memory period will be 40 milliseconds. The resolution in the 10 kHz analysis range is:<br><br>10 kHz/400 lines of resolution = 25 Hz.<br>The reciprocal of 25 Hz = 1/25 = 40 mS. |
| **7.** X-axis display parameter. | Hz-X axis display information in Hertz.<br>KCPM-X axis display information in kilocycles per minute.<br>ORDER-Harmonic relationships in orders.<br>SECONDS-Time in seconds or milliseconds. |
| **8.** Value at the Y-axis position of the cursor. | V-Volts<br>dB-Decibels<br>EU-Engineering units<br>PSD-Power spectral density represented by $EU^2/Hz$. |
| **9.** X-axis format of the spectrum information. | LIN or LOG |
| **10.** Value at the X-axis position of the cursor. | Hz-X axis value in Hertz.<br>KCPM-X axis value kilocycles per minute.<br>ORDER-Cursor position in orders.<br>MSECOND-Cursor position in milliseconds or seconds. |

**Table 3-4. Description of Figure 3-5a, b & c. (Continued)**

| Display Information | Display Variation |
|---|---|
| **11.** Scaled grid line corresponding to the selection described in **12.** | A numerical value in V, dB, EU or PSD. |
| **12.** Y-axis display parameter. | V-Y axis display information in Volts.<br>dB-Y asix display information in decibels.<br>EU-Y axis display information in engineering units.<br>PSD-Y axis display information of power spectral density. |
| **13.** Full scale display value of the Y-axis parameter. | A numerical value in V, dB, Eu or PSD. |
| **14.** Example of a dual display combination. | Example is the SPECT mode, LIST combination 5. (refer to Figure 3-6, example **9**.) |
| **15.** Number of spectra averaged. | 2 through 1024 ensembles in binary sequence or 1 through 1024 ensembles utilizing the +1 mode. |
| **16.** Averager Mode. | RT-Real Time<br>AVG-Linear summation<br>EXPO-Exponential<br>PK-Peak |

### 3.5.3 Display Combination Selection

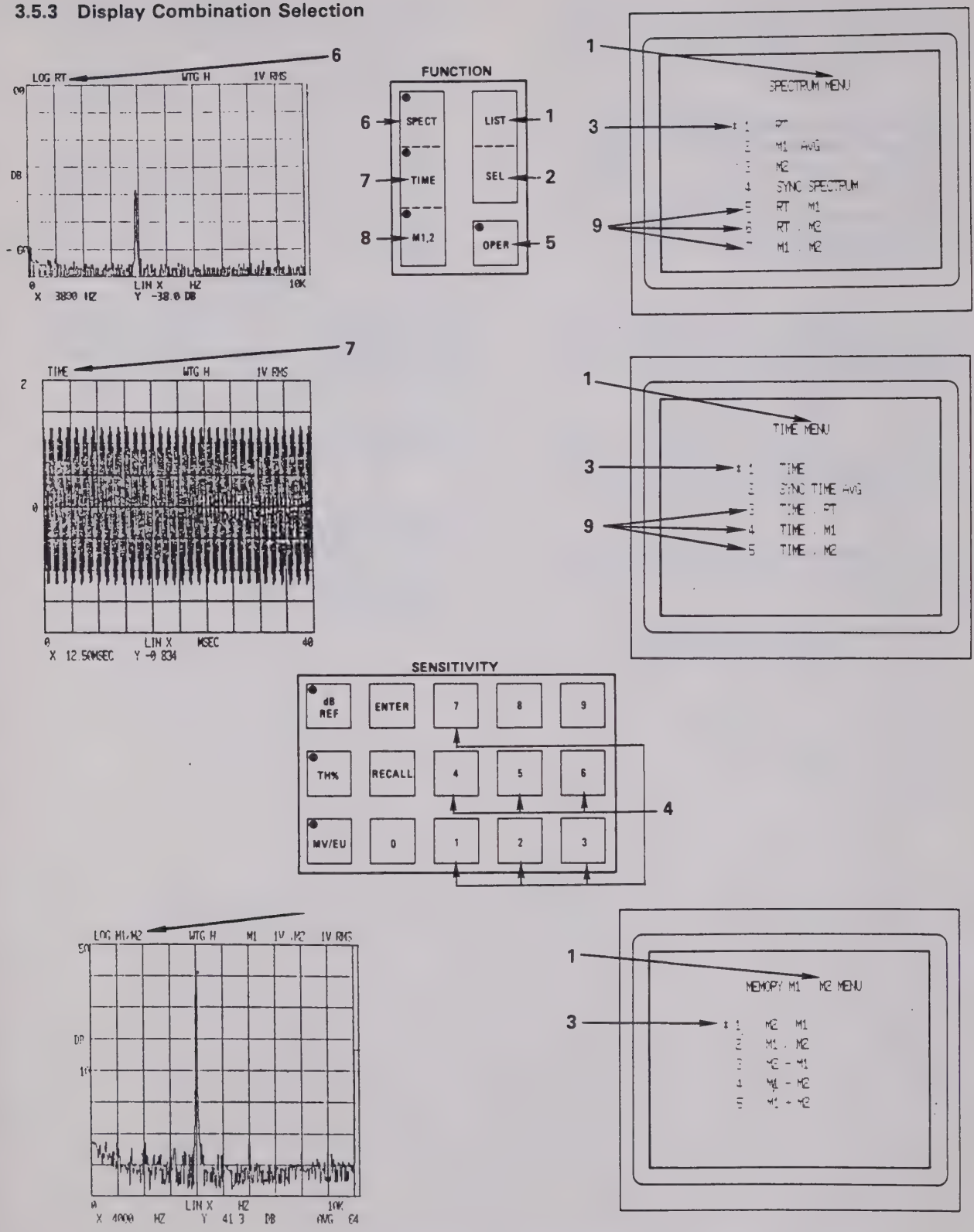



**Figure 3-6. CRT Display Combinations and Controls.**

1. One of the LEDS on touch controls **6, 7** or **8** will always be lighted. When LIST is depressed, the MENU information displayed will correspond to the lighted LED on touch controls **6, 7** or **8.**

2. The SEL touch control sequences through MENU selection without displaying the MENU and without random selection. For example, if the instrument is in the SPECT mode and it is desired to change from display 2 to display 1, the SEL touch control will have to be stepped from 2 through 7 and then to 1.

3. The asterisk indicates the display function that is selected. Changing the selection in the LIST or the SEL modes will move the asterisk to the display function selected by the operator.

4. When a MENU is displayed, SENSITIVITY keyboard numbers 1 through 7 are used to select the corresponding item on the MENU display.

5. After MENU selection is accomplished, depress the OPER touch control to display the desired information.

6. Depress this touch control to select the SPECT mode. There are seven different displays that can be selected in the SPECT mode. Selection can be performed by two methods. One is the LIST function (refer to **1**). The other method is the SEL function (refer to **2**).

7. Depress this touch control to select the TIME mode. There are five different displays that can be selected in the TIME mode. Selection can be made in the same manner as described in the SPECT mode.

8. Depress this touch control to select the MEMORY M1, M2 mode. There are five different displays that can be selected in this mode. Selection can be made in the same manner as described in the SPECT mode.

9. Dual display combinations.

**NOTE**

Use the LIST mode to display stored M1 and M2 information. *DO NOT* use the SEL mode to display stored M1 and M2 information.

### 3.5.4 SENSITIVITY Selection

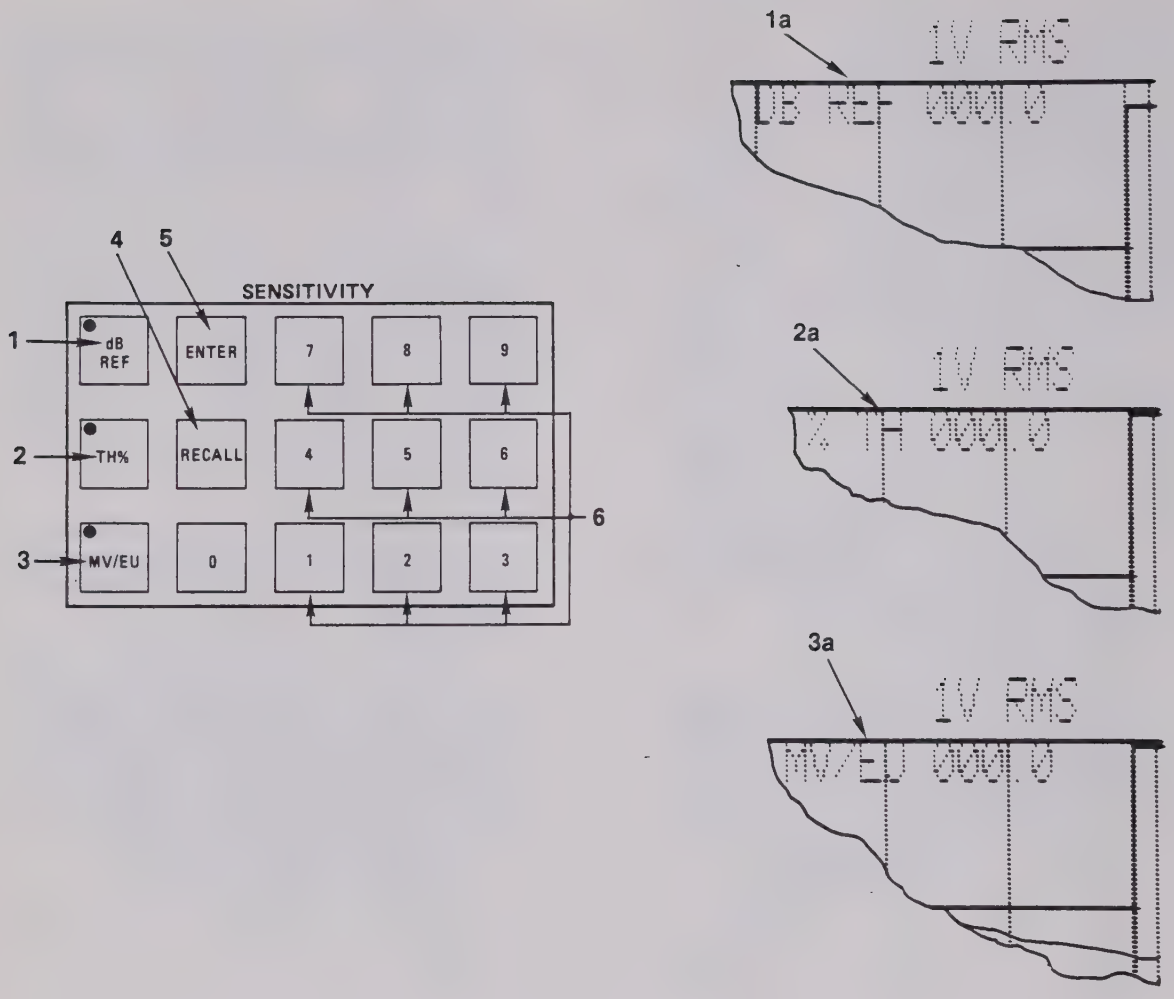



**Figure 3-7. SENSITIVITY Group Touch Controls and Portions of the CRT Display.**

1. This touch control is used to select dB reference at any point on the display. Depressing this control will light the LED on the dB REF control and the display will appear as shown in Figure 3-7, example **1a**. Move the cursor to the desired reference point and select the dB value via the keyboard numbered controls (refer to **6**). This is accomplished as follows: If it is desired to reference the selected point to 40 dB, depress the dB REF control, depress the number four on the keyboard and depress the zero twice. The display as illustrated in Figure 3-7, example **1a**, will now read dB REF 040.0. When this is accomplished, depress the ENTER control. The crt grid scaling will change to conform with the selected dB reference (refer to Figure 3-5a, **11, 12, 13**) and the information as illustrated in Figure 3-7, **1a** will disappear from the display after a few moments. If it is desired to recall the value entered, depress the dB REF control and then the RECALL control. dB REF cannot be selected while in the TIME, RT dual display mode of operation (refer to Figure 3-6).

2. This touch control is used to select threshold percentage for the transient capture function. Depressing this control will light the LED on the TH% control and the display will appear as shown in Figure 3-7, example **2a**. Selection, entering, recalling and changing values is the same as described in **1.**

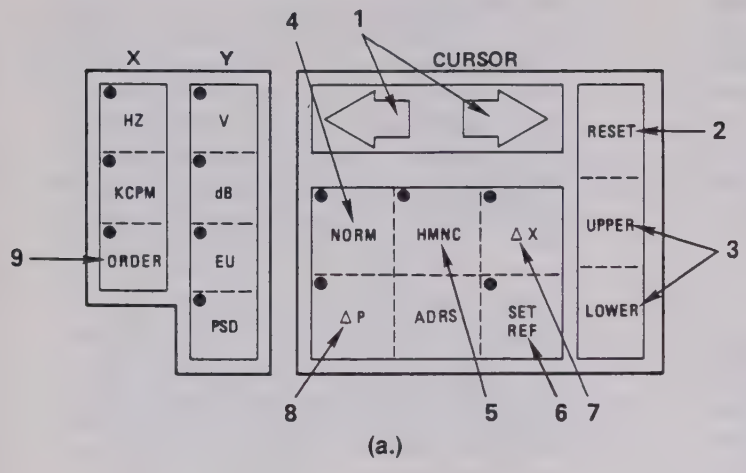
3. This touch control is used to select transducer sensitivity in units of mV/EU. Depressing this control will light the LED on the mV/EU control and the display will appear as shown in Figure 3-7 example **3a.** Selection, entering, recalling and changing values is the same as described in **1.**

4. This touch control is used to recall the values selected by **1, 2,** or **3**. This is accomplished by first depressing controls **1, 2,** or **3**, and then by depressing the RECALL control. If the operator desires to change the selected sensitivity values, depress the dB REF, TH% or mV/EU touch controls, select the new value on the keyboard, then depress the ENTER touch control.

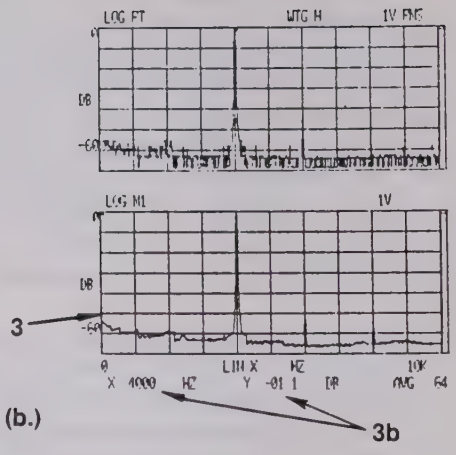
5. This touch control is used to enter the sensitivity values selected for functions **1, 2,** or **3**. After the desired values have been selected, depress the ENTER control.

6. The keyboard numbered touch controls have a dual function capability. The first function is to select values to be entered for dB reference, threshold percentage, or transducer sensitivity in mV/EU. The second function is described in paragraph 3.5.3, example **4.**

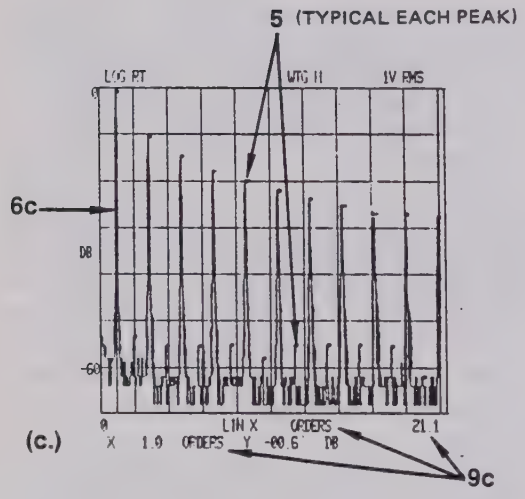
### 3.5.5 CURSOR Group Functions



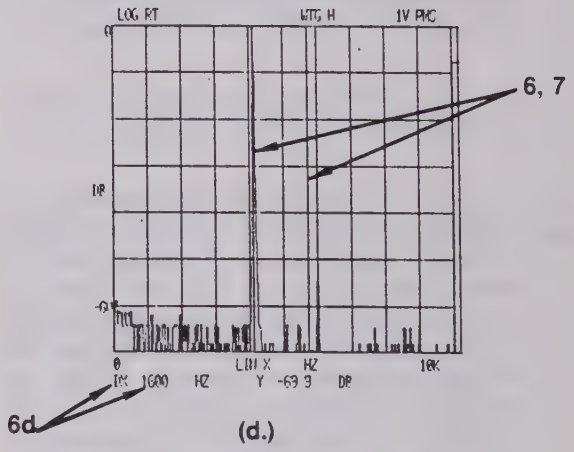

(a.)



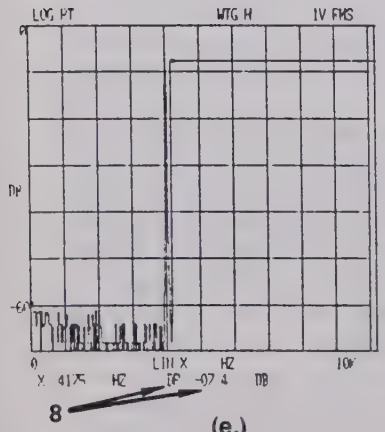

(b.)



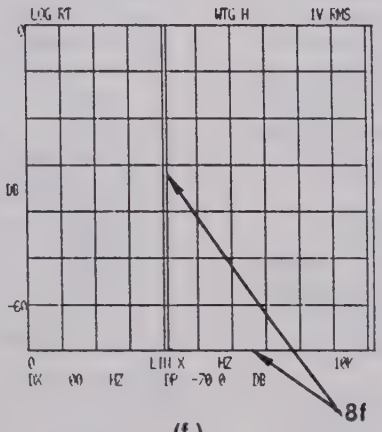

(c.)



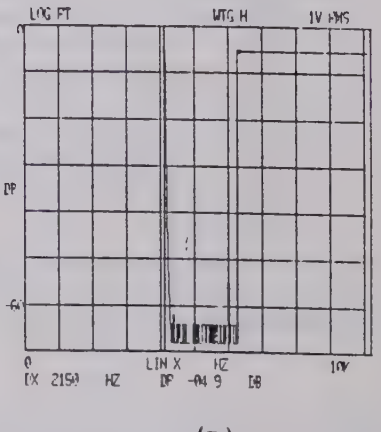

(d.)




(e.)




(f.)




(g.)

**Figure 3-8. CURSOR Group Controls and Related Display Functions.**

1. These touch controls move the cursor (intensified dot) to the left or right. Depressing either control once will move the cursor one cell to the left or right depending on which of the pointed controls are depressed. Depressing either one of the controls without releasing will cause a line cursor to appear and move in the desired direction until the control is released. As soon as the control is released, the line cursor will disappear.

2. This touch control resets the cursor to cell 1.

3. These touch controls place the cursor (intensified dot) on either the upper or lower trace in a dual display mode (refer to Figure 3-8b, **3**). When the cursor control is held in the depressed position, a line cursor will appear and move on both traces. The alphanumeric information on the bottom of the display will reflect value changes only for the trace where the cursor (intensified dot) is located (refer to Figure 3-8b, **3b**).

4. This touch control places the cursor (intensified dot) in the normal mode of operation.

5. This touch control places an intensified dot at all multiples of the cursor location (refer to Figure 3-8c, **5**). In most cases the intensified dots will not be perfectly aligned with the harmonics. To permit more precise alignment, the fundamental cursor now has a finer resolution of 256 parts per cell. Alignment can be achieved by moving the cursor control as required. After alignment is accomplished, depress the SET REF control (refer to Figure 3-8a, **6**). This freezes the positions of the intensified dots and a line cursor appears at the fundamental (refer to Figure 3-8c, **6c**). The line cursor (intensified dot plus vertical line) can now be moved to any of the 400 cell locations. Orders referenced to fundamental can now be read out on the crt alphanumerics (refer to Figure 3-8c, **9c**) by depressing the ORDER touch control (refer to Figure 3-8a, **9**).

6. The SET REF touch control is used in the harmonic mode as described in **5** and in the ΔX mode as described in **7.**

**NOTE**

Prior to using the ΔX mode, the CURSOR Group X units, Hz touch control must be depressed.

7. This touch control can be used in conjunction with the normal **4**, harmonic **5** and ΔP **8** modes. The ΔX, ΔP combination will be discussed in explanation **8**. When ΔX is selected in the NORM mode, a permanent line cursor will appear with the intensified dot. If SET REF is not depressed, the instrument will be in the NORM mode with a permanent line cursor. If SET REF is depressed after ΔX is depressed, the line cursor will become frozen at its present position and another line cursor accompanied by the intensified dot will appear when the cursor is moved to the left or right (refer to Figure 3-8d, **6, 7**). The X-axis value will be referenced to the frozen line cursor and the X-axis cursor values will be designated DX representing the difference between the frozeh line cursor and the movable line cursor (refer to Figure 3-8d, **6d**). The ΔX mode can also be utilized while the instrument is in the HMNC, SET REF mode. This is accomplished as follows: After performing the functions as described in **5**, move the cursor to the desired point on the display. Depress ΔX. The SET REF LED will go out. Depress SET REF. The SET REF LED will come back on. ΔX will not function as described in the NORM mode. To go back to the original HMNC, SET REF condition, depress SET REF then depress HMNC. The instrument will return to the original HMNC, SET REF setting. Note that while in the ΔX NORM, ΔX HMNC or ΔXΔP modes that HZ, KCPM and ORDERS will read zero at the frozen cursor position.

8. This touch control provides a summation of the rms value of the power level of all the displayed information to the left of the cursor regardless of its position on the display (refer to Figure 3-8e). The Y-axis cursor value will be designated DP representing the rms value of the displayed spectrum information (refer to Figure 3-8e, **8**). Moving the cursor will vary the power level. The ΔX mode can also be used in conjunction with Δ². This is accomplished as follows: Position the cursor at the desired location. Depress ΔX, SET REF and ΔP in that order. The display will appear as a solid vertical line and a solid horizontal base line as shown in Figure 3-8f, **8f**. Moving the cursor to the right will cause the display to appear as shown in Figure 3-8g.

9. This touch control displays the X-axis location of the cursor in terms of its harmonic relationship to the fundamental component when the instrument is in the harmonic mode of operation (refer to Figure 3-8c).

### 3.5.6 Operational Notes

The following subparagraphs contain answers to some of the most often asked questions concerning the operation of the SD345.

a. If the cursor is located in cell 1 and the CURSOR Group ORDER touch control is selected, the full scale annotated order number is not correct and should be ignored. Correct full scale orders are annotated for cells 2 through 400.

b. The full scale EU and PSD may not correspond to the full scale voltage depending upon the MV/EU sensitivity entered. The analyzer will select the closest and correct full scale EU or PSD value in a 1, 2, 5 sequence. In all cases, the data is correctly scaled.

c. PSD is always scaled for rms data. For valid PSD readouts, the data must always be collected with the Input Group RMS touch control selected. PSD cannot be selected in the Integrate or Differentiate modes.

d. The level of the Overall signal is always calculated, displayed and scaled for rms. Therefore, the level of the Overall signal height will be lower in displayed amplitude than the highest narrowband spectrum peak when the O-P or P-P Input Level parameter is selected.

e. If the Digital Translator ('-1' Option) is installed and used in the Time mode, the translated time domain cursor readouts should be ignored.

f. EU and PSD scaling and cursor readouts are not valid if no value for MV/EU is entered after Power On. If a self test is performed after Power On, 10 MV/EU is the default sensitivity and is automatically selected and entered.

g. Time mode display with the TH% selected — The cursor readouts always indicate data values at the threshold crossing regardless of where the cursor is located. Select MV/EU to read any part of the displayed time mode waveform with the cursor.

h. Sensitivity values for dB REF, TH% and MV/EU are not retained in the PANEL STORE mode. These values must be re-entered after Power On.

i. LOG X Display — The display freezes whether in SINGLE or DUAL display mode when PLOTTER RESET is depressed. The display does not freeze when LIN X1 is selected.

j. If LIN X4 expansion is required while plotting, select LIN X4 before selecting PLOTTER RESET. If PLOTTER RESET is selected first, the display freezes and data is not expanded, yet the X-axis annotation will say that it is. PLOTTER RESET freezes the X4 display. If PLOTTER START, STOP and START are depressed in that sequence, the plotter will move all the data through the X4 display window.

k. PSD cannot be selected in the P-P or O-P modes. The RMS mode must be selected for PSD. Also, after PSD is selected, the P-P and O-P modes cannot be selected.

l. Full scale grid annotation and data trace position on the display will not change between certain successive Input Level changes when displaying dB REF. The transition points are *data dependent*.

m. Crt annotation reads DBR to the left of the grid when dB REF is selected.

n. During active LIN averaging, if the average number is reduced it can cause an improperly normalized display.

o. Grid annotation is limited to E-9 ($1 \times 10^{-9}$) and readouts/scaling to E±11 ($1 \times 10^{\pm 11}$). The general rule is: TRY TO KEEP READOUTS TO E±11, AND BE CAUTIOUS OF READOUTS OUTSIDE THIS RANGE.

p. The Integration mode is disabled for the Translator and 1/3 Octave Options.

q. No Translated KCPM readouts.

r. Frequency and Translated annotation are not stored with M1 or M2 data.

s. DB REF cannot be set in the FUNCTION group, M1,2 mode.

t. Changing the Input Level or Analysis Range during averaging will cause erroneous data.

u. Time Mode — Translated — Displays all of the imaginary components of the zoom (Translated) time data, and SEC/MSEC alphanumeric readout is meaningless.

v. If the Average function is in progress, and the Menu is used to step through the displays, the average can be lost. There is no interlock between Time/Spectrum data.

w. Integration and Δ P are incompatible.

x. Digital overall and integration are incompatible, and therefore overall is set to a small number.

y. The intensified dots that appear when ORDERS are selected do not appear when the Translator Option is used.

## 3.6 OPERATIONAL CHECKOUT

The following paragraphs contain an operational checkout of the Model SD345. The procedures should be accomplished before and after calibration or maintenance is performed. It is also recommended as a performance check upon receipt of the instrument. The operator should become thoroughly familiar with the front and rear panel descriptions given in this section before performing the operational checkout.

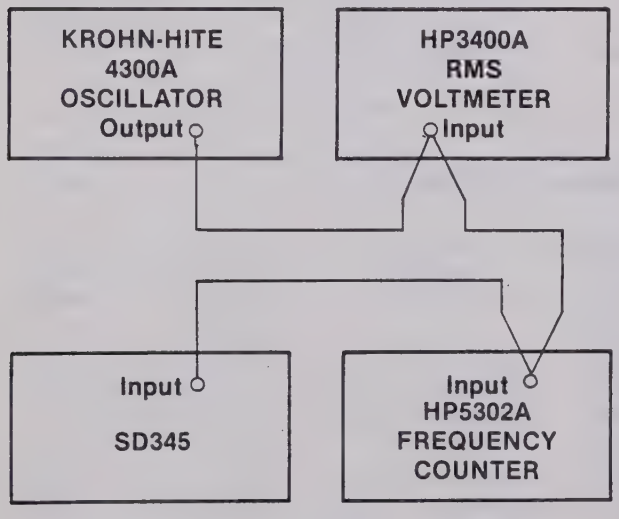
### 3.6.1 Setup

Equipment required for the checkout is given in Table 3.5. Instruments with equal or better operational characteristics may be substituted.

**Table 3-5. Equipment Required**

| Name | Model No. | Manufacturer |
|---|---|---|
| Oscillator (Signal Gen.) | 4300A | Krohn-Hite |
| RMS Voltmeter | 3400A | Hewlett Packard |
| Frequency Counter | 5302A/5300A | Hewlett Packard |

a. Interconnect the test equipment to the instrument as shown below:




b. Apply power to all units and allow approximately fifteen minutes warm-up time before proceeding.

c. Select the controls on the SD345 as indicated below:

| | |
|---|---|
| RANGE, FREQ | 10K |
| VOLTS | 1 |
| LEVEL | RMS |
| SENSITIVITY GROUP | MV/EU |
| DISPLAY Y-GAIN | LOG (Left side of graticule should read 0 and −60 dB. If this condition is not displayed, depress the GAIN controls until the proper attenuation is displayed.) |
| DISPLAY X-GAIN | LIN, X1 |
| CURSOR GROUP | NORM |
| AVG N | 16 (The selected number of averages is not displayed in SPECTRUM MENU, combination 1. To display the average number selected, select SPECTRUM MENU, combination 2. The number of averages will appear in the lower right corner of the crt just below the selected frequency range. After the proper number of averages has been selected, return to SPECTRUM MENU, combination 1.) |

d. Adjust the crt Contrast and Grid controls for the best presentation.

e. Adjust the Signal Generator to provide a 4 kHz sine wave at 1 Vrms ±30 mVrms.

f. Insure that SPECTRUM MENU combination 1 is selected and observe a full scale spectrum display on the crt with the overall signal displayed at the extreme right.

g. Carefully adjust the frequency of the input signal for a symmetrical display. Re-adjust the amplitude of the input signal to 1 Vrms ±30 mVrms.

### 3.6.2 Linearity Check

a. Operate the CURSOR LEFT/RIGHT control to place the cursor on the peak of the spectrum on the crt display. Depress the CURSOR group Y units V control. Observe that the alphanumeric Y-axis value reads 1.000 Vrms (0.970 to 1.030 Vrms).

b. Operate the CURSOR LEFT/RIGHT control to place the cursor on the peak of the overall signal on the crt display. Observe that the alphanumeric Y-axis value reads 1.000 Vrms (0.970 to 1.030 Vrms).

c. Select the 10 Vrms range via the LEVEL, VOLTS controls. Depress the CURSOR group RESET control to reset the cursor to the start of the trace. Depress the CURSOR group Y units dB control. Utilizing the DISPLAY Y GAIN controls, step through all seven GAIN positions and observe that the alphanumeric Y-axis values read as shown in Table 3-6.

**Table 3-6. GAIN Selection**

| GAIN Selection | Graticule Reading | Y-Axis Value |
|---|---|---|
| 0 dB Gain-Display | 0 dB to -60 dB | Below -60 dB |
| 10 dB Gain-Display | -10 dB to -70 dB | Below -60 dB |
| 20 dB Gain-Display | -20 dB to -80 dB | Below -60 dB |
| 30 dB Gain-Display | -30 dB to -90 dB | Below -60 dB |
| 10 dB Atten-Display | +10 dB to -50 dB | -60 dB |
| 20 dB Atten-Display | +20 dB to -40 dB | -50 dB |
| 30 dB Atten-Display | +30 dB to -30 dB | -40 dB |

d. Readjust the Signal Generator for an output of 10mVrms. Select the 0.01 Vrms range via the LEVEL, VOLTS controls. Operate the CURSOR LEFT/RIGHT control to place the cursor on the peak of the spectrum on the crt display.

e. Refer to Table 3-7 and for the first three positions of the VOLTS control (0.01V, 0.02V, and 0.05V), compare the alphanumeric display reading (refer to paragraph 3.5.2, example 8) with that listed in the SPECTRUM column of the table.

f. Return the VOLTS control to the 0.01 Vrms range. Operate the CURSOR LEFT/RIGHT control to place the cursor on the peak of the overall signal on the crt display. Repeat step e, comparing the alphanumeric display reading with that listed in the OVERALL column on the table.

g. Return the VOLTS control to the 0.01 Vrms range. Operate the CURSOR LEFT/RIGHT control to the left until the X-axis value reads 4200 Hz (200 Hz to the right of the input signal). Depress the CURSOR group ΔP control. Repeat step e, comparing the alphanumeric display reading with that listed in the ΔP column on the table.

h. Depress the CURSOR group NORM control.

i. Readjust the Signal Generator for an output of 100 mVrms. Select the 0.1 Vrms range scale via the LEVEL, VOLTS controls. Operate the CURSOR LEFT/RIGHT control to place the cursor on the peak of the spectrum on the crt display.

**Table 3-7. Spectrum, Overall and ΔP Linearity**

| Volts | Atten | Spectrum | Overall | ΔP |
|---|---|---|---|---|
| (10 mV input) | | | | |
| 0.01 | 0 dB | 0.0 dB ± 0.2 dB | 0.0 dB ± 0.2 dB | 0.0 dB ± 0.2 dB |
| 0.02 | -6 dB | -06.0 dB ± 1.0 dB | -06.0 dB ± 1.0 dB | -06.0 dB ± 1.0 dB |
| 0.05 | -14 dB | -14.0 dB ± 1.0 dB | -14.0 dB ± 1.0 dB | -14.0 dB ± 1.0 dB |
| (100 mV input) | | | | |
| 0.1 | 0 dB | 0.0 dB ± 0.2 dB | 0.0 dB ± 0.2 dB | 0.0 dB ± 0.2 dB |
| 0.2 | -6 dB | -06.0 dB ± 1.0 dB | -06.0 dB ± 1.0 dB | -06.0 dB ± 1.0 dB |
| 0.5 | -14 dB | -14.0 dB ± 1.0 dB | -14.0 dB ± 1.0 dB | -14.0 dB ± 1.0 dB |
| 1 | -20 dB | -20.0 dB ± 1.0 dB | -20.0 dB ± 1.0 dB | -20.0 dB ± 1.0 dB |
| 2 | -26 dB | -26.0 dB ± 1.0 dB | -26.0 dB ± 1.5 dB | -26.0 dB ± 1.5 dB |
| 5 | -34 dB | -34.0 dB ± 1.0 dB | -34.0 dB ± 3.0 dB | -34.0 dB ± 3.0 dB |
| 10 | -40 dB | -40.0 dB ± 1.0 dB | -40.0 dB ± 3.0 dB | -40.0 dB ± 3.0 dB |
| 20 | -46 dB | -46.0 dB ± 1.0 dB | -46.0 dB ± 3.0 dB | -46.0 dB ± 3.0 dB |

j. Refer to Table 3-7 and for the last eight positions on the VOLTS control (0.1V, 0.2V, 0.5V, 1V, 2V, 5V, 10V, and 20V), compare the alphanumeric display reading (refer to paragraph 3.5.2, example 8) with that listed in the SPECTRUM column of the table.

k. Return the VOLTS control to the 0.1 Vrms range. Operate the CURSOR LEFT/RIGHT control to place the cursor on the peak of the overall signal on the crt display. Repeat step j, comparing the alphanumeric display reading with that listed in the OVERALL column on the table. For each of the last three voltage ranges, (5V, 10V, and 20V), insure that the AVG group LIN control is depressed (LED lighted) and then initiate averaging by first depressing the ERASE control and then the START control.

l. Return the VOLTS control to the 0.1 Vrms range. Operate the CURSOR LEFT/RIGHT control to the left until the X-axis value reads 4200 HZ (200 Hz to the right of the input signal). Depress the CURSOR group ΔP control. Repeat step j, comparing the alphanumeric display reading with that listed in the ΔP column on the table.

m. Depress the CURSOR group NORM control.

### 3.6.3 Alphanumeric Display (Hz and KCPM) Check

a. Insure that the SIGNAL group UPDATE control is selected (LED lighted).

b. Depress the SIGNAL group TEST control.

c. In the PLOTTER group, depress the CAL control and then the FS control.

d. For each selection of the RANGE, FREQ controls, place the CURSOR group X units controls first in the HZ position and then in the KCPM position. Observe the alphanumeric display readings (refer to paragraph 3.5.2, example 10.) in each frequency range selection and compare them with the readings listed in the FULL SCALE column of Table 3-8.

e. Depress the PLOTTER group CAL control once to remove the CAL, FS signal. Operate the CURSOR LEFT/RIGHT control to place the cursor on the peak of the TEST signal fundamental on the crt display.

f. For each selection of the RANGE, FREQ controls, place the CURSOR group X units controls first in the Hz position and then in the KCPM position. Observe the alphanumeric display

**Table 3-8. Alphanumeric Display Readings (Hz and KCPM)**

| Freq Range | Full Scale | | Test Sig Fund | | Cell 1 | |
|---|---|---|---|---|---|---|
| | Hz | KCPM | Hz | KCPM | Hz | KCPM |
| 100K | 100000 | 6000 | 64000 | 3840 | 250 | 15 |
| 50K | 50000 | 3000 | 32000 | 1920 | 125 | 7.5 |
| 20K | 20000 | 1200 | 12800 | 768 | 50 | 03 |
| 10K | 10000 | 600.0 | 6400 | 384.0 | 25 | 1.5 |
| 5K | 5000.0 | 300.00 | 3200.0 | 192.00 | 12.5 | 0.75 |
| 2K | 2000 | 120.0 | 1280 | 76.8 | 05 | 0.3 |
| 1K | 1000.0 | 60.00 | 640.0 | 38.4 | 2.5 | 0.15 |
| 500 | 500.00 | 30.000 | 320.00 | 19.200 | 1.25 | 0.075 |
| 200 | 200.0 | 12.00 | 128.0 | 7.68 | 0.5 | 0.03 |
| 100 | 100.00 | 6.000 | 64.0 | 3.84 | 0.25 | 0.015 |
| 50 | 50.000 | 3.0000 | 32.000 | 1.9200 | 0.125 | 0.0075 |
| 20 | 20.00 | 1.200 | 12.80 | 0.768 | 0.05 | 0.003 |
| 10 | 10.000 | 0.6000 | 6.400 | 0.3840 | 0.025 | 0.0015 |
| 5 | 5.0000 | 0.3000 | 3.2000 | 0.1920 | 0.0125 | 0.0007 |
| 2 | 2.000 | 0.1200 | 1.280 | 0.0768 | 0.005 | 0.0003 |
| 1 | 1.000 | 0.0600 | 0.6400 | 0.0384 | 0.0025 | 0.0001 |

readings (refer to paragraph 3.5.2, example 10.) in each frequency range selection and compare them with the readings listed in the TEST SIG FUND column of Table 3-8.

g. Depress the CURSOR group RESET control to reset the cursor to cell 1.

h. For each selection of the RANGE, FREQ controls, place the CURSOR group X units controls first in the HZ position and then in the KCPM position. Observe the alphanumeric display readings (refer to paragraph 3.5.2, example 10.) in each frequency range selection and compare them with the readings listed in the CELL 1 column of Table 3-8.

### 3.6.4 Alphanumeric Display (ORDERS) Check

a. Depress the SIGNAL group AC control to remove the test signal.

b. Select the 20K analysis range via the RANGE, FREQ controls. Adjust the signal generator to provide a square wave at 950 Hz ± 3 Hz.

c. Select the 0.1 Vrms range via the LEVEL, VOLTS controls and adjust the output of the signal generator to approximately 100 mVrms (no overload indicated on the LED located on the upper left corner of the Display Y GAIN touch control).

d. Operate the CURSOR LEFT/RIGHT control to place the cursor on the peak of the fundamental on the crt display. Depress the CURSOR group HMNC control and observe that intensified dots appear at all multiples (harmonics) of the cursor location.

e. Operate the CURSOR LEFT/RIGHT control left or right to place all the intensified dots on the peaks of their associated harmonics. (In this mode, the cursor will move at a rate of 1/256 times normal speed for finer resolution.)

f. Depress the CURSOR group SET REF control to freeze the dots. Observe that a vertical line cursor appears along with the intensified dot on the peak of the fundamental.

g. Depress the CURSOR group X units ORDER control and observe that the alphanumeric display reads 1.0 ORDERS (refer to Figure 3-8, example 9c).

h. Depress the Display X group X4 control and observe that the crt display expands 12.5 percent of the X-axis spectrum on either side of the cursor. Depress the Display X group X1 control.

i. Operate the CURSOR LEFT/RIGHT control to move and accurately position the line cursor so that it coincides with the intensified dot on the peak of the second harmonic (order). Observe that the alphanumeric display reads the correct order (2.0). (The second harmonic will be the low signal between the first and third. The odd harmonics will have the highest amplitude.)

j. Repeat step i for each of the 21 harmonics (orders) on the crt display and in each case observe that the alphanumeric display reads the correct order.

### 3.6.5 Alphanumeric Display (V) Check

a. Depress the following controls as indicated:

| | |
|---|---|
| PLOTTER GROUP | CAL, FS |
| DISPLAY X GROUP | LIN, X1 |
| CURSOR GROUP | NORM |
| CURSOR GROUP Y UNITS | V |
| CURSOR GROUP X UNITS | HZ |

b. For each position of the LEVEL, VOLTS control, compare the alphanumeric display readings with the readings listed in the CAL, FS column of Table 3-9.

**NOTE**

Values with the indication E-1 or E1 indicate scientific notation. For example: 5.00 E-4 translates to $5 \times 10^{-4}$ and 2.00 E3 translates to $2 \times 10^{3}$.

**Table 3-9. Alphanumeric Display Readings (V).**

| Level, Volts | CAL, FS | CAL, 0,.01 |
|---|---|---|
| 0.01 | 1.00 E-2 | 1.00 E-4 |
| 0.02 | 2.00 E-2 | 2.00 E-4 |
| 0.05 | 5.00 E-2 | 5.00 E-4 |
| 0.1 | 0.100 | 1.00 E-3 |
| 0.2 | 0.200 | 2.00 E-3 |
| 0.5 | 0.500 | 5.00 E-3 |
| 1 | 1.000 | 1.00 E-2 |
| 2 | 2.000 | 2.00 E-2 |
| 5 | 5.000 | 5.00 E-2 |
| 10 | 10.00 | 0.100 |
| 20 | 20.00 | 0.200 |

c. Depress the PLOTTER GROUP 0,.01 control.

d. For each position of the LEVEL, VOLTS control, compare the alphanumeric display readings with the readings listed in the CAL, 0,.01 column of Table 3-9.

### 3.6.6 Alphanumeric Display (dB) Check

a. Insure that the PLOTTER group CAL, 0,.01 controls are selected. Depress the CURSOR group Y units dB control. Observe that the Y-axis value reads −40.0 dB.

b. Depress the Display Mode Y, LIN control and observe that the Y-axis value reads −70.0 dB. Depress the Display Mode Y, Log control.

c. Depress the PLOTTER group FS control and observe that the Y-axis value reads 0.0 dB.

d. Refer to paragraph 3.5.4 Example 1 and enter the following values for dB reference and observe that the Y-axis values as described in paragraph 3.5.2 Example 8, match the SENSITIVITY reference settings as described in paragraph 3.5.4 Example 1 and 1a:

1. 0.0 to 1.0 in steps of 0.1
2. 1.0 to 10.0 in steps of 1.0.
3. 10.0 to 100.0 in steps of 10.0.

e. In the LEVEL, VOLTS group, select the 20V range and insure that the RMS control is selected.

f. On the SENSITIVITY group keyboard, select and enter a dB reference of 200.0.

g. For each selection of the VOLTS control, compare the alphanumeric Y-axis value and upper graticule reading with the dB REF given in the following table:

| Volts | dB Ref |
|---|---|
| 20 | 200.0 |
| 10 | 194.0 |
| 5 | 188.0 |
| 2 | 180.0 |
| 1 | 174.0 |
| 0.5 | 168.0 |
| 0.2 | 160.0 |
| 0.2 | 154.0 |
| 0.05 | 148.0 |
| 0.02 | 140.0 |
| 0.01 | 134.0 |

**Alphanumeric Display (EU) Check**

a. Depress the following controls:

| | |
|---|---|
| CURSOR GROUP Y UNITS | EU |
| SENSITIVITY GROUP | MV/EU |
| SENSITIVITY KEYBOARD | 001.0 (Refer to paragraph 3.5.4 for selecting and entering values.) |
| PLOTTER GROUP | CAL, FS |

b. For each of the VOLTS ranges, compare the Y axis alphanumeric readings with the EU readings given in the CAL, FS column of Table 3-10.

c. Depress the PLOTTER group 0,.01 control. For each of the VOLTS ranges, compare the Y axis alphanumeric readings with the EU readings given in the CAL, 0,.01 column of Table 3-10.

**Table 3-10. Alphanumeric Display Readings (EU).**

| Volts | CAL, FS | CAL, 0,.01 |
|---|---|---|
| 0.01 | 10.00 | 200.0 |
| 0.02 | 20.00 | 0.200 |
| 0.05 | 50.00 | 0.500 |
| 0.1 | 100.0 | 1.000 |
| 0.2 | 200.0 | 2.000 |
| 0.5 | 500.0 | 5.000 |
| 1.0 | 1000 | 10.00 |
| 2.0 | 2000 | 20.00 |
| 5.0 | 5000 | 50.00 |
| 10.0 | 1.00 E4 | 100.0 |
| 20.0 | 2.00 E4 | 200.0 |

d. Select 1 Vrms via the LEVEL, VOLTS controls. Depress the PLOTTER group CAL, FS controls. For each SENSITIVITY selected via the SENSITIVITY KEYBOARD as shown in the following table, compare the Y axis alphanumeric display

readings with the readings listed in the second column of the following table:

| Sensitivity (mV/EU) | EU Reading |
|---|---|
| 0.0 | 1000 |
| 0.5 | 1000 |
| 1.0 | 1000 |
| 2.0 | 500.0 |
| 3.0 | 500.0 |
| 4.0 | 500.0 |
| 5.0 | 200.0 |
| 6.0 | 200.0 |
| 10.0 | 100.0 |
| 20.0 | 50.00 |
| 50.0 | 20.00 |
| 100.0 | 10.00 |
| 200.0 | 5.000 |
| 500.0 | 2.000 |

e. Depress the PLOTTER group CAL control once to remove the CAL, FS signal.

f. Select and enter a value of 001.0 for MV/EU via the SENSITIVITY KEYBOARD.

g. Adjust the signal generator to provide a 4KHz sine wave at 1 Vrms ± 0.005 Vrms. Carefully adjust the frequency of the signal generator for a symmetrical spectrum display. Operate the CURSOR LEFT/RIGHT control to place the cursor on the peak of the spectrum on the crt display.

h. For each setting of the SENSITIVITY KEYBOARD controls shown in the following table, compare the alphanumeric display readings with the listed EU readings. As each new SENSITIVITY selection is made, observe the automatic attenuation of the spectrum on the crt display. This automatic attenuation is designed to achieve full scale of 1,2,2.5,4 or 5 sequence.

**NOTE**

The amount of attenuation can be observed by switching the CURSOR group Y units controls between dB and EU.

| Sensitivity (mV/EU) | Alphanumeric Y Axis Values | |
|---|---|---|
| 12.3 | 81.30 | (79.60 to 83.00) |
| 23.4 | 42.70 | (41.70 to 43.70) |
| 34.5 | 29.00 | (28.40 to 29.60) |
| 45.6 | 21.90 | (21.40 to 22.40) |
| 56.7 | 17.64 | (17.24 to 18.00) |
| 67.8 | 14.75 | (14.45 to 15.05) |
| 78.9 | 12.67 | (12.37 to 12.97) |
| 89.0 | 11.24 | (10.94 to 11.54) |
| 90.1 | 11.10 | (10.80 to 11.40) |
| 109.0 | 9.170 | (8.970 to 9.370) |
| 210.0 | 4.760 | (4.660 to 4.860) |
| 321.0 | 3.120 | (3.060 to 3.180) |
| 432.0 | 2.310 | (2.260 to 2.360) |
| 543.0 | 1.842 | (1.802 to 1.882) |
| 654.0 | 1.529 | (1.499 to 1.559) |
| 765.0 | 1.307 | (1.277 to 1.337) |
| 876.0 | 1.141 | (1.120 to 1.163) |
| 987.0 | 1.013 | (0.993 to 1.033) |

i. Depress the CURSOR group Y units dB control. Observe that the Y axis alphanumeric display reads 0.0.

### 3.6.7 Analysis Mode Check

a. Refer to paragraph 3.5.3 and select SPECTRUM MENU combination 5. (Dual display of RT and M1.)

b. Depress the SENSITIVITY group MV/EU control and the CURSOR group X units HZ control.

c. Insure that the AVG group LIN and STOP controls are selected (LED lighted). Depress the ERASE and then the START controls and observe that the averaged information from the upper trace is transferred to the lower trace.

d. Disconnect the input signal and observe that the crt display continues to display the values held in M1.

e. With the input signal disconnected, depress the AVG group ERASE control. Observe that the information on both traces appears as a baseline.

f. Depress the SIGNAL group TEST control.

g. Depress the AVG group START control. Observe that the number of averages as displayed below the lower trace starts at one and counts to the number of averages selected and

then stops. Observe that the LED located on the STOP control is lighted and the LED on the START control has gone out.

h. Depress the AVG group ERASE, PEAK and START controls in that order. Observe that the information displayed in M1 is updated with only higher values.

i. Depress the SIGNAL group AC control. Observe that the LED on the TEST control goes out and the upper trace appears as a baseline. Also observe that the previously averaged information is present on the lower trace.

j. Reconnect the signal generator and observe that the 4KHz signal appears on both traces. (Lower trace will still have the TEST signal displayed.) Insure that the cursor is on the peak of the spectrum on the upper trace. This is accomplished by depressing the CURSOR group UPPER control and then utilizing the CURSOR LEFT/RIGHT control to position the cursor on the peak of the spectrum.

k. In the AVG group, depress the LIN and ERASE controls. For each selected number of averages on the following table, observe the time required for the LED on the STOP control to light. Averaging must be initiated for each number of averages selected. This is accomplished by first depressing the ERASE control and then the START control.

| Avg N | Lin Avg Time (Approx) |
|---|---|
| 32 | 7 Sec. |
| 64 | 13 Sec. |
| 256 | 52 Sec. |

### 3.6.8 LIN Y-GAIN Check

a. Refer to paragraph 3.5.3 and select SPECTRUM MENU combination 1. (Single display of RT.) Adjust the signal generator to provide a 4KHz sine wave at 0.25 Vrms ±5 mVrms.

b. Select the 1 Vrms range scale via the VOLTS, LEVEL controls. Select V via the CURSOR group Y-units control.

c. Operate the CURSOR LEFT/RIGHT control to place the cursor on the peak of the spectrum on the crt display.

d. Depress the Display Mode Y, LIN control. Step through all four positions provided by the GAIN touch controls. (X1, X2, X5, and X10.) Observe that the Y-axis values read 0.25 Vrms ±5 mVrms in all four positions of the Display Y GAIN controls.

### 3.6.9 Time Mode Check

a. Select the controls on the SD345 as indicated below:

| | |
|---|---|
| RANGE, FREQ | 10K |
| VOLTS | 1 |
| LEVEL | RMS |
| FUNCTION GROUP | TIME MENU, COMBINATION 1. (Refer to paragraph 3.5.3 for MENU selection.) |
| CURSOR GROUP X UNITS | HZ |
| CURSOR GROUP Y UNITS | dB |
| SIGNAL GROUP | UPDATE, AC |

b. Adjust the signal generator to provide a 100Hz sine wave at 1 Vrms ± 30 mVrms.

c. Depress the SIGNAL group HOLD control and observe that the CRT displays approximately four cycles of the 100Hz sine wave.

### 3.6.10 Arithmetic Function (M1,2) Check

a. Select the controls on the SD345 as indicated below:

| | |
|---|---|
| RANGE, FREQ | 10K |
| VOLTS | 1 |
| LEVEL | RMS |
| FUNCTION GROUP | SPECTRUM MENU, COMBINATION 1. (Refer to paragraph 3.5.3 for MENU selection.) |

| | |
|---|---|
| CURSOR GROUP (Y UNITS) | V |
| AVG N | 16 (The selected number of averages is not displayed in SPECTRUM MENU, combination 1. To display the average number selected, select SPECTRUM MENU, combination 2. The number of averages will appear in the lower right corner of the crt just below the selected frequency range. After the proper number of averages has been selected, return to SPECTRUM MENU, combination 1.) |

b. Adjust the Signal Generator to provide a 4KHz sine wave at 0.5 Vrms ±2 mVrms.

c. Operate the CURSOR LEFT/RIGHT control to place the cursor on the peak of the spectrum on the crt display. Carefully readjust the Signal Generator amplitude control until the Y-axis value on the SD345 crt display reads 0.5 Vrms ± 2 mVrms.

d. Refer to paragraph 3.5.3 and select SPECTRUM MENU, combination 5. (Dual display of FT and M1.)

e. Initiate averaging by selecting the following controls in the indicated sequence: LIN, ERASE, and START. Observe that the averaging takes place on the lower trace (M1). When averaging is completed, transfer the cursor from the peak of the spectrum on the upper trace to the peak of the spectrum on the lower trace utilizing the CURSOR group UPPER and LOWER touch controls. Insure that the spectrum amplitude Y-axis value still reads 0.5 Vrms ± 2 mVrms.

f. Refer to paragraph 3.5.3 and select SPECTRUM MENU, combination 7. (Dual display of M1 and M2.)

g. Depress the XFER, M1→M2 control and observe that the information on the upper trace is transferred to the lower trace.

h. Select the FUNCTION group M1,2 mode and for each combination of the MEMORY M1, M2 MENU, compare the Y-axis values with the values listed on Table 3-11a.

i. Return the display to SPECTRUM MENU, combination 1 and readjust the Signal Generator amplitude for an output of 1 Vrms. Repeat steps d through g, replacing the voltage values in steps d through g with 1 Vrms ± 2mVrms. Do not depress the XFER, M1 M2 controls as the 0.5 Vrms signal in M2 is going to be arithmetically combined with the 1 Vrms signal.

j. Select the FUNCTION group M1,2 mode and for each combination of the MEMORY M1, M2 MENU, compare the Y-axis values with the values listed on Table 3-11b.

**Table 3-11a M1, 2 Arithmetic Functions**

| M1 = 0.5 Vrms<br>Memory M1, M2 Function | M2 = 0.5 Vrms<br>Y-Axis Value |
|---|---|
| 1. M2/M1 | 1.0 V/V ± 3 mVrms |
| 2. M1/M2 | 1.0 V/V ± 3 mVrms |
| 3. M2 - M1 | 00 V |
| 4. M1 - M2 | 00 V |
| 5. M1 + M2 | 0.707 V ± 3 mVrms |

**Table 3-11b. M1, 2 Arithmetic Functions**

| M1 = 1.0 Vrms<br>Memory M1, M2 Function | M2 = 0.5 Vrms<br>Y-Axis Value |
|---|---|
| 1. M2/M1 | 0.500 V/V ± 3 mVrms |
| 2. M1/M2 | 2.000 V/V ± 12 mVrms |
| 3. M2 - M1 | 00 V |
| 4. M1 - M2 | 0.866 V ± 3 mVrms |
| 5. M1 + M2 | 1.118 V ± 3 mVrms |

## 3.7 OPERATOR MAINTENANCE

### 3.7.1 Introduction

Maintenance to be performed by the operator is limited to cleaning, visual inspection, periodic checks, and only limited trouble shooting.

### 3.7.2 Cleaning

Operator cleaning procedures involve only the exterior surfaces. When the instrument is operating, use only a dry cloth or soft brush. The SD345 is equipped with a LEXAN front panel. The following guidelines should be used in selecting a proper cleaning agent.

**CAUTION**

Only recommended cleaning agents should be used for cleaning the LEXAN front panel. Many commercial cleaning agents contain some form of halogenated, aromatic or ammoniated compounds. These agents will damage the LEXAN front panel and should not be used for cleaning.

The recommended cleaning agents are as follows:

Light cleaning: Denatured alcohol or a mild solution of soap and water.

Heavy cleaning: MS-260 cleaner for plastic, glass and metal. (Miller Stephenson Chemical Co., Inc.)

The following procedure should be performed at least once each month. If the instrument is being used in a dust-filled environment cleaning may be required each day.

**CAUTION**

Do not use any air source to remove dust.

a. Turn the instrument off and disconnect the AC power cord.

b. Using a soft brush, remove dust from the front panel and the face of the CRT. Remove dust from all connectors, slots, switches, and the vent fan foam filter on the rear panel.

c. Using the recommended cleaning agents, wipe the front panel and the face of the CRT.

### 3.7.3 Operator Checks

The table below lists some possible malfunctions that may be corrected by interpreting the front panel indications and taking the appropriate action.

The Front Panel Control Familiarization listed in paragraph 3.5 and the Operational Checkout listed in paragraph 3.6 can be performed to verify that the instrument is functioning properly.

If after performing the above checks, the instrument is not operating properly, notify maintenance personnel.

| Malfunction Symptoms | Possible Cause |
|---|---|
| No Display and Power Pushbutton/Indicator is in the ON position but not lighted. | 1. Loose power cord at wall receptacle or at rear of instrument.<br>2. Fuse is blown.<br>3. No power at wall receptacle. |
| No Display. Power Pushbutton/Indicator is in the ON position and the lamp is lighted. | 1. CRT intensity is too low. |
| No Input Signal. | 1. Input signal not connected or loose; Depress TEST to verify. |
| Input Signal and Grid but no Alphanumerics. | 1. Rear-panel AUX SW SIP Switch, S2, position 1 is in the OFF position. (This switch turns the CRT Alphanumerics on and off.) |

## SECTION IV

## CONCEPT OF OPERATION

### 4.1 GENERAL

Figure 4-1 shows the overall concept of operation of the Model SD345. The major functional sections of the instrument are controlled from the front panel, via the Z80 Microprocessor, through appropriate timing and control circuitry. Analog input data is conditioned, digitized, and written into Input Memory. All subsequent processing is handled digitally. In the digital sections, tri-state bussing is employed throughout. Digital-to-Analog converters in the Output Control and Display Section are used to generate analog output signals for the crt and an external X-Y plotter. The following paragraphs give a functional description of the SD345 based on Figure 4-1.

### 4.2 CONCEPT OF OPERATION

#### 4.2.1 Timing and Input Control

The Timing and Input control circuits generate the basic timing for the entire instrument. In addition, they generate the clock for the Z80 Microprocessor control, the Input Section and the writing of data into the Input Memory. Upon demand by the Microprogram Control Section, the Timing and Input Control Section causes the

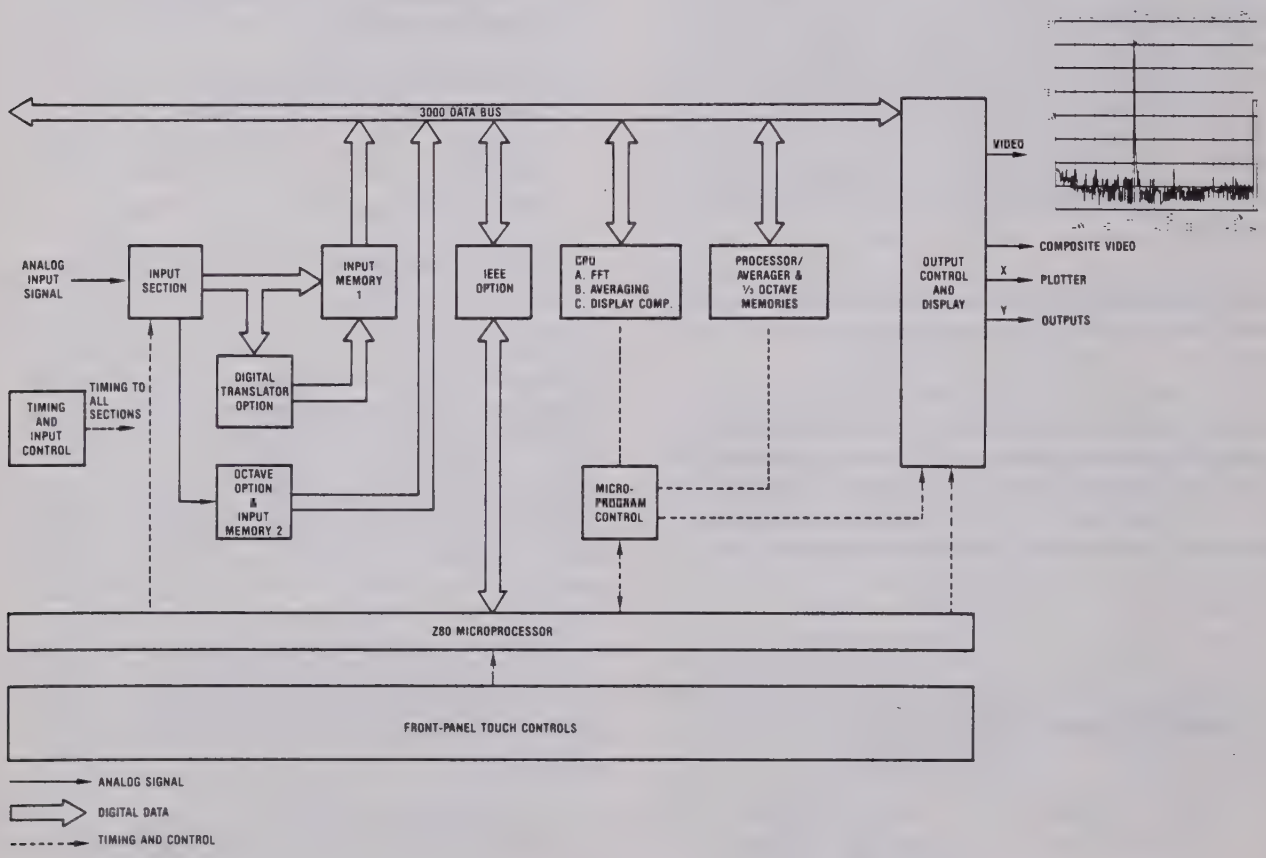



**Figure 4-1. SD345 Concept of Operation.**

Input Memory to transfer a block of stored digital information to the Processor Memory.

### 4.2.2 Input Section

The time-domain analog input signal is applied to the Input Section where it is either attenuated or amplified to provide a normalized signal to the Low Pass Filter. The Normalized Input Signal is passed through the low-pass filter so that components at higher frequencies cannot produce aliasing terms when analyzed in the frequency domain. The filtered analog signal is then amplified in the post-filter gain stage, sampled, and the samples are converted to a 10-bit digital word. This word sequence is a digital representation of the applied analog signal.

### 4.2.3 Input Memory

Alternate data samples from the Input Section are treated as "even" and "odd" samples. The "even" samples are used to produce the "real" part of a complex word and the "odd" samples are used to produce the "imaginary" part of the complex word. Consecutive "even" and "odd" samples are paired and stored in the 1024 X 10-bit Input Memory. The "even" samples are stored in the "real" section of the memory and the "odd" samples are stored in the "imaginary" section of the memory.

Figure 4-2 illustrates this operation. Paired samples are treated as complex words (i.e., $S_0 + jS_1$; $S_2 + jS_3$; $S_4 + jS_5$; etc.) For use by the CPU section.

Upon demand by the Microprogram Control Section, a block of 512 complex words will be transferred from the Input Memory to the Processor Memory for processing by the CPU section. The block that is transferred consists of the most recent samples of the input analog signal.

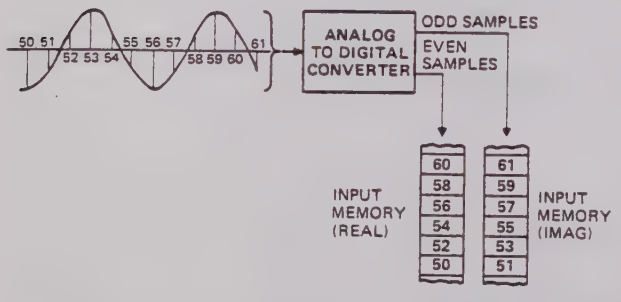



**Figure 4-2. Input Memory Organization**

### 4.2.4 Microprogram Control Section

This section provides the timing and control for controlling the Data Bus and for the processing functions performed by the CPU Section. It contains control PROM's which are capable of providing over 5000 24-bit machine language instructions. Front-panel Z80 Microprocessor control configurations, as well as the states of various circuits throughout the instrument, are monitored in order to control the sequence in which the instructions are fetched from the control PROM's.

### 4.2.5 CPU Section and Processor/Averager Memories

The CPU Section consists of a Central Processing Element (CPE) composed of seven bipolar 2-bit slices; a hardware multiplier; ROM lookup tables for Sine and Cosine; and PROM lookup tables for Weighting, Square Root, EU-PSD, LOG X and LOG Y. This section performs all the required arithmetic and logical functions for the following operations:

a. A high-speed implementation of the Fast-Fourier Transform (with or without weighting).

b. Averaging of the real-time data stored in Processor Memory.

c. Computations for CRT signal and Alphanumeric Display.

The Processor Memory is a 1024 × 14-bit memory whose function is to store data during processing by the CPU Section. It also serves as a storage memory for the transformed, rectangular, real-time data.

There are two Averager Memories. Averager Memory 1 is a 1024 × 11-bit memory whose function is to store averaged or peak information depending on the selected analysis mode (LIN or PEAK). Averager Memory 2 is also a 1024 × 11-bit memory whose function is to store the information from Averager Memory 1 for later use or for arithmetic functions between Averager Memory 1 and Averager Memory 2. An Extended Average Memory is used for performing floating point Sync Time Averaging.

When a block of data is transfered from the Input Memory, the CPU multiplies the data by a weighted function (Hanning or Rectangular) and stores the results in the Processor Memory. The CPU Section then computes the FFT. The resultant transformed data is then stored in the Processor Memory in rectangular format. Upon completion of processing, the contents of the Processor

Memory is available to the Output Memory for display purposes.

If either the LIN, EXPO, or PEAK mode has been selected, the CPU Section performs the selected operation on the real-time data from the Processor Memory and stores the results in Averager Memory 1. The contents of Averager Memory 1 are available to Averager Memory 2 and the Display Control Section for display. When data has been stored in this memory, it is retained until a new average or peak operation is initiated.

The contents of either the Processor Memory (real-time data) or the Averager memory (averaged or peak data) may be selected for crt display by means of the front-panel FUNCTION Group. Upon demand by the Microprogram Control Section, the CPU performs the required computations (depending upon the selected DISPLAY Y-GAIN), on the selected data to scale it for proper display. The data is then denormalized to 9 bits and written into a CRT Refresh Memory in the Output Control and Display Section. Also upon demand by the Microprogram Control Section, the CPU performs the required computations (depending upon the selected CURSOR UNITS) on the data at the cursor address. This data is then sent to the Video Interface, Character Generator and displayed on the crt as alphanumerics.

### 4.2.6 Output Control and Display Section

This section consists of all the required circuitry, including timing and control, for displaying data on the crt display and for providing the remote, plotter and composite video outputs.

Output control PROM's (RFSH) provide the necessary instructions for accomplishing these functions. The Z80 Microprocessor configurations, as well as the states of various circuits are monitored in order to control the sequence in which the instructions are fetched from the PROM's.

Digital X-axis data is generated by an X-axis Counter and then converted to analog data. This analog data is the normal (X1) X-axis sweep signal. An expanded (X4) X-axis sweep signal is generated by using a DC Cursor Location signal to determine the portion of the normal sweep to be expanded. Either the normal (X1) or the expanded (X4) sweep signal may be selected for the X-axis by means of the front-panel Display X controls.

The digital data from the X-axis Counter also provides the read address for the Refresh Memory.

The data in the Refresh Memory (frequency-domain) is loaded into TV Memory for display. Either this frequency-domain data or the digitized time-domain data from the Input Section may be selected for display on the TV by means of the front-panel FUNCTION Group.

The cursor circuits employ up/down counters to generate either a NORMAL cursor or a HARMONIC cursor depending upon the position of the front-panel CURSOR Group controls. The counters are controlled by the CURSOR LEFT/RIGHT control. The X-axis sweep is intensified when the count of the X-axis Counter is equal to the count of the Cursor Counter. This causes the cursor to appear on the crt as a square dot. When the dot is being moved across the crt display, a vertical line cursor is also generated and displayed along with the intensified dot. When HARMONIC cursor is selected, intensified dots are also placed on the X-axis sweep at all multiples of the fundamental cursor location. In this mode, the CURSOR LEFT/RIGHT control can be used to position the fundamental cursor at any of 256 steps between adjacent cell locations. This provides finer resolution for aligning higher order harmonics. After the harmonics have been aligned, if the SET REF touch control is depressed, the intensified dots at the harmonic positions are frozen and a vertical line cursor is generated and displayed on the crt. This line cursor can then be moved to any of the 400 cell locations (512 cell locations for time) to allow readout of the selected cursor data on the crt alphanumeric display.

When the PLOTTER mode is selected a selectable 10Hz or 20Hz clock from the Timing and Input Control Section clocks the Cursor Counter continuously so that the cursor sweeps across the X-axis sweep on the crt. Each time the Cursor Counter and the X-axis Counter are equal, a Frequency Match signal is generated. This signal controls an X Sample-and-Hold and a Y Sample-and-Hold. The X-axis analog signal and the Y-axis analog data (frequency-domain) are applied to these Sample-and-Hold circuits. The outputs of these circuits is dc proportional to the data at the cursor location and is routed to the rear-panel PLOTTER X and PLOTTER Y connectors. A Sweep Rate Feedback circuit monitors the rate of change of the Y-axis data, and when it exceeds a preselected slope, slows the sweep to allow sufficient time for the plotter to record the data peak.

# Scientific-Atlanta Service Information

Scientific-Atlanta has sales and service centers around the world. In addition, an international network of sales representatives is available to assist you anywhere in the world.

## Product Support Programs

### Customer Support

At Scientific-Atlanta, we are committed to supporting the instruments we sell. This philosophy is demonstrated through a world-wide sales and service organization which provides a variety of services to our customers.

### Service Centers

Scientific-Atlanta maintains a network of service centers around the world. These centers are staffed and equipped to handle most maintenance requirements. In addition, the service center can provide technical assistance on problems related to the application, operation, or maintenance of our products.

- Service representatives are factory trained on each product.
- Specialized knowledge and test equipment is available to provide local repair with minimum downtime.
- The service representatives have the experience to provide on-site calibration and maintenance of individual instruments or entire systems.

To insure continued customer satisfaction, each service center is equipped to provide several types of service:

### Warranty Service

Each Scientific-Atlanta manufactured instrument is tested and inspected to conform to its published specifications and to be free of defects in materials and workmanship. Scientific-Atlanta will repair or replace products which prove to be defective within the warranty period. Detailed warranty information is included in the applicable instrument instruction manual. For more information, contact the Scientific-Atlanta office nearest you.

If an instrument develops a defect within the warranty period, contact your Scientific-Atlanta service center. Your Service Representative will help determine the best course of action for effecting the repair of your equipment; all without parts or labor expense to you.

### Annual Service Agreement

An annual service agreement is an economical and effective way to assure continued high instrument performance. Periodic scheduled maintenance and calibration is the best insurance against equipment failure. It is a cost-effective means of preventing expensive production interruptions or delays in development programs. You are assured of timely, competent service without the expense of maintaining in-house maintenance capability, specialized test equipment, and replacement parts inventories.

Some of the outstanding advantages of an Annual Service Agreement are:

- Regularly scheduled maintenance and calibration.
- Reduced labor rates — approximately 20% saving over unscheduled field service.
- Quick response on emergency service — normally within 48 hours.
- Facilitates maintenance budgeting.
- Minimizes paperwork — one purchase order covers the entire year.
- On-site service of instruments or entire system — reduces downtime, eliminates problems related to sending individual instruments to the calibration laboratory.

### Field Service

Field Service is available to assist you with stubborn maintenance problems, installations, and other technical problems. If field service is required, contact your Scientific-Atlanta service center.

### In-House Service

In some cases it is more efficient or cost effective to return equipment to our service center. Your Service Representative will gladly work with you to determine when this is necessary and will provide you with shipping instructions.

### Replacement Parts

Each service center maintains inventories of most replacement parts for current standard products. In most cases, emergency orders for parts, printed circuit boards, subassemblies, and supplies can be filled within 24 hours. Ordering parts from Scientific-Atlanta provides you with a single source of supply and assurance of part compatibility.

When ordering parts from Scientific-Atlanta, please provide a description, part number, model number, and serial number.

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